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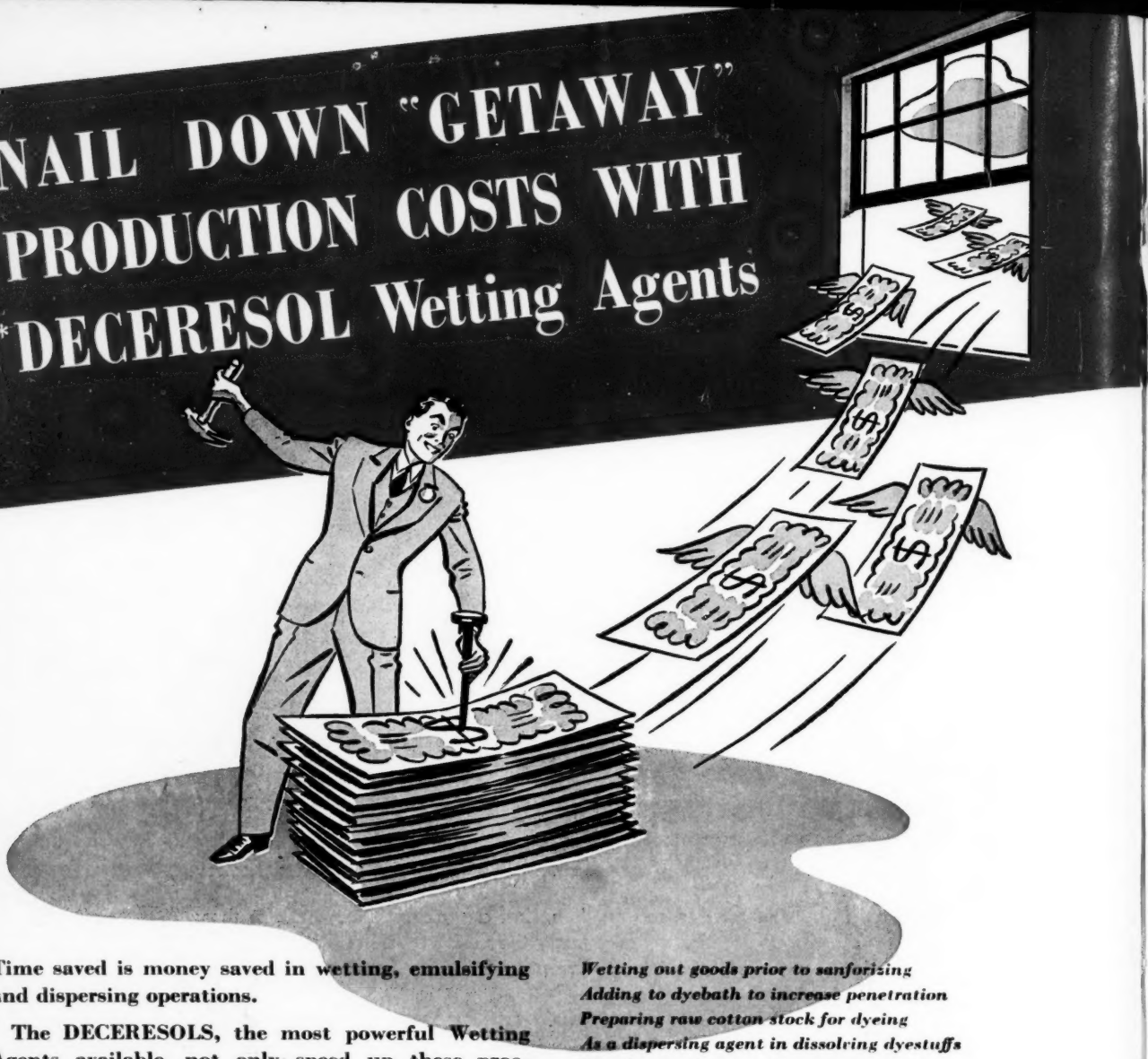

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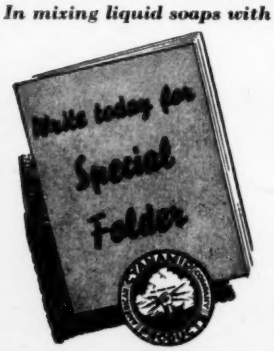

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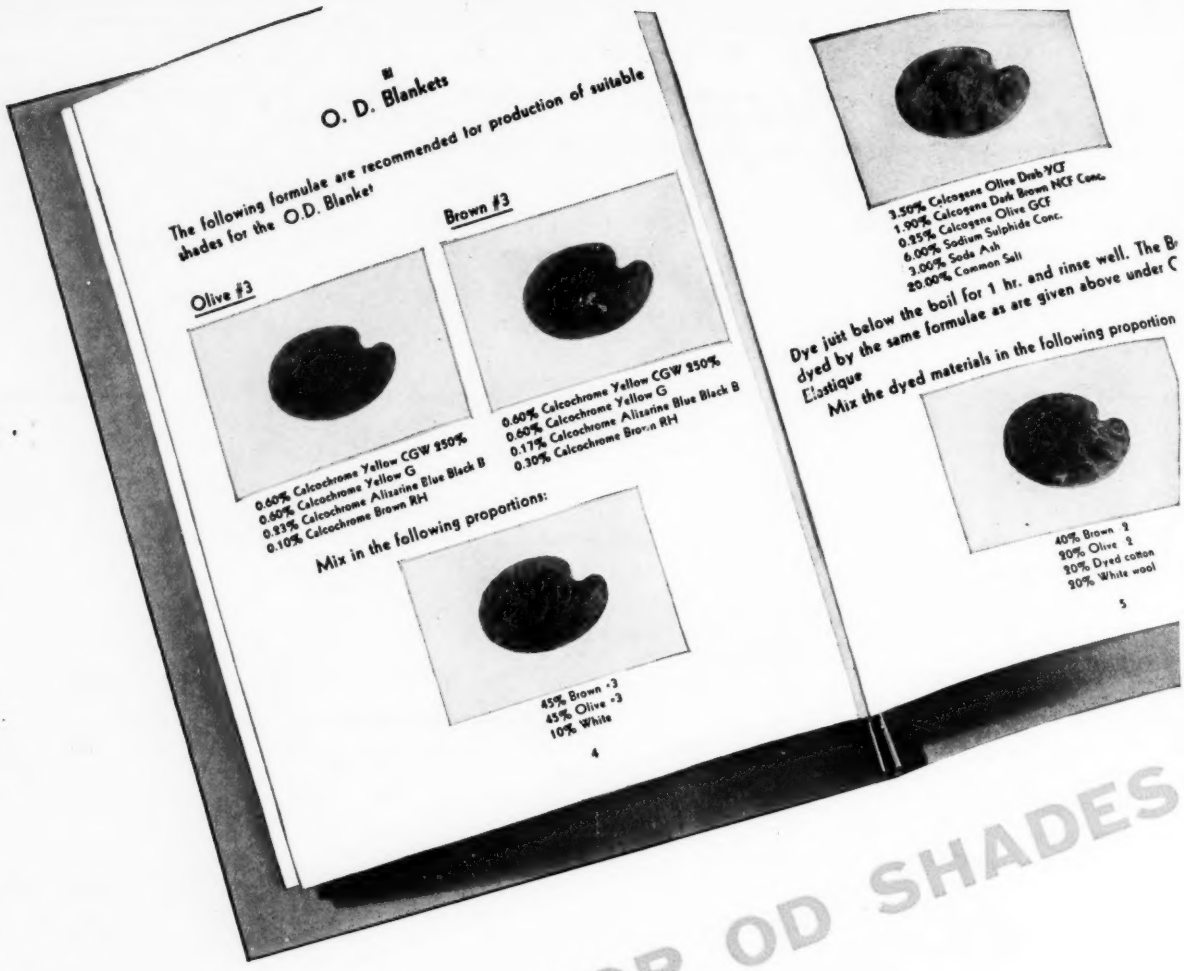
O. D. Blankets
The following formulae are recommended for production of suitable shades for the O.D. Blanket
Olive #3
0.60% Calcochrome Yellow CGW 250%
0.60% Calcochrome Yellow G
0.23% Calcochrome Alizarine Blue Black B
0.10% Calcochrome Brown RH
Brown #3
0.60% Calcochrome Yellow CGW 250%
0.60% Calcochrome Yellow G
0.17% Calcochrome Alizarine Blue Black B
0.30% Calcochrome Brown RH
Mix in the following proportions:
45% Brown #3
45% Olive #3
10% White
4
3.50% Calcogene Olive Drab YCF
1.90% Calcogene Dark Brown NCF Conc.
0.25% Calcogene Olive GCF
6.00% Sodium Sulphide Conc.
3.00% Soda Ash
20.00% Common Salt
Dye just below the boil for 1 hr. and rinse well. The B
dyed by the same formulae as are given above under C
Elastique
Mix the dyed materials in the following proportion
40% Brown 2
20% Olive 2
20% Dyed cotton
20% White wool
5

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DYESTUFF REPORTER

VOLUME 30 FEBRUARY 17, 1941 NUMBER 4

Damage to Wool Garments During Bleaching

CHARLES S. LOWE, A. C. LLOYD, and ADRIAN C. SMITH*

IN a number of instances it has been observed that one or two wool garments out of several in a sodium perborate bleaching bath are damaged. The damaged wool usually feels slippery and is often rubbery or elastic. In extreme cases it may become jelly-like. On drying it is usually stiff, yellow, and shrunken, having an appearance similar to wool damaged by caustic soda or other strong alkali. The sodium perborate bleach is usually made up in a soap solution in lukewarm water, at a concentration of one ounce of perborate per gallon of water, and has a pH of 9.6. Soaking for several hours or overnight under these conditions would not be expected to produce such an effect.

This phenomenon was believed to be caused by a gradual accumulation of caustic soda in the bath with continued use according to the reaction

$$4\ NaBO_3 + 5\ H_2O = Na_2B_4O_7 + 4\ H_2O_2 + 2\ NaOH$$

and the cleaner was instructed to prepare a fresh bleaching bath every day. It was still difficult to explain why all the garments in a particular bath were not damaged, the effect apparently being confined to a few pieces. This investigation was undertaken to determine whether an increased susceptibility of wool to deterioration during wet treatments, especially with slightly alkaline reagents, was caused by previous oxidizing or reducing treatment. The general procedure followed was to bleach conditioned wool samples with perborate, permanganate, bisulfite, hydrosulfite, and formaldehyde sulfoxylate for varying lengths of time after which the solubility in 0.1 N alkali was determined. Alkali solubilities were determined on samples bleached with the reducing agents followed by treatment in perborate and vice versa. The solubility in a commercial digestive agent, used by cleaners for removing albumen or blood stains, of samples bleached with perborate was also studied, since a great many instances where wool apparently has been damaged in a digestive bath have been noted.

*National Association of Dyers and Cleaners, Silver Spring, Md.

EXPERIMENTAL DETAILS

Cloth of white worsted yarn prepared from unbleached wool was used in this work. The material was washed with soap and water, treated overnight in a digestive bath, extracted with methyl alcohol and ethyl ether successively for 6 hours each in a soxhlet apparatus, washed with Stoddard solvent and finally with distilled water at 50° C.

One perborate bleaching consisted of 16 hours soaking at 30° C. in a bath containing 1 oz. of sodium perborate per gallon (0.8 per cent), analytical reagent grade, and 0.1 per cent coconut oil soap. In a separate series to determine the alkali build up, the strength of the bath was determined after each 16 hour bleaching period and perborate was added in amount sufficient to restore approximately to the original concentration. It was found difficult to add perborate in amount to give exactly the original concentration since it dissolves slowly and some oxygen is lost during the solution process. Series were also run in which the concentration of perborate was maintained at 2 oz. per gallon. The strength was determined by pipetting a 25 ml. sample into 50 ml. of water, adding 5 ml. of 20 per cent KI with 5 ml. of 6 N H_2SO_4, and titrating after standing one hour with 0.1 N $Na_2S_2O_3$ using starch solution as indicator. pH values were determined with a glass electrode, Hellige meter No. 373.

Permanganate bleaching was carried out for 1 minute periods at 30° C. in solutions of 0.5 per cent and 1 per cent concentration, each containing 1.5 per cent acetic acid. After removing from the bath the samples were rinsed and treated with hydrogen peroxide and acetic acid to remove any brown color.

All reducing agents were used in 1.5 per cent solutions at boiling temperature for 10 minute periods. Water lost by evaporation was automatically replaced by connecting the bleaching vessel with another beaker over which was inverted a bottle of water. This arrangement prevented any increase in concentration of the bleach during the boiling. The reducing agents employed were of a technical

grade ordinarily used by a cleaning plant. The formaldehyde sulfoxylate bleach was studied both with and without addition of 1 per cent acetic acid; bisulfite was used with 1 per cent acetic acid; no acid was added to the hydrosulfite bath.

Alkali solubilities were determined by the method of Harris and Smith.[1] The dried samples were weighed and treated with a 0.1 N solution of sodium hydroxide at 65° C. for 1 hour, approximately one gram samples being immersed in 100 ml. of alkali solution. The wool was transferred to a Buchner funnel, washed with distilled water until no color was obtained with phenolphthalein when applied to the wool, dried to constant weight at 105° C., and the loss in weight determined.

In connection with the effect of reducing agents on wool, iodine absorption values were determined as follows: 0.5 g. of the wool samples was cut into fine pieces, placed in a 250 ml. flask with 50 ml. of water. 25 ml. of 0.05 N iodine solution was added and the excess iodine was titrated with 0.06 N $Na_2S_2O_3$ after a period of 2 hours. The end point was taken as the point at which 2 drops of $Na_2S_2O_3$ in excess of the amount required to destroy the starch blue color, prevented the blue color from returning for at least 5 minutes.

Solubility in a neutral digestive bath was obtained by immersing in a 0.2 per cent solution of a commercial digestive agent at 30° C. for 6 hours, rinsing thoroughly, drying to constant weight at 105° C., and determining the loss in weight.

RESULTS AND DISCUSSION

(1) Effect of Oxidizing Agents on Wool

The alkali solubility of wool subjected to successive overnight (16 hours) bleaching in sodium perborate and to 1 min. bleachings in 0.5 per cent and 1 per cent permanganate solutions is shown in Fig. 1. A new perborate bleaching bath was prepared for each overnight bleaching period. No visible damage or harsh feel was apparent after 12 perborate bleachings although the solubility in alkali had increased over 32 per cent. The condition, after drying, of the samples treated with permanganate as determined visually and by feeling them is given in Table 1.

TABLE 1
Condition of Wool Samples after Bleaching in Permanganate

Number of One Min. Bleachings	*After Bleaching in 0.5% Solution*	*After Bleaching in 1% Solution*
1	Unaffected	Unaffected
2	Unaffected	Unaffected
3	Unaffected	Slightly harsh
4	Slightly harsh	Harsh
5	Slightly harsh	Harsh
6	Harsh	Very harsh
7	Very harsh	Slightly stiff
8	Very harsh	Stiff
9	Slightly stiff	Very stiff
10	Slightly stiff	Very stiff and brittle

Although the 1 per cent solution of permanganate has more effect on the wool than the 0.5 per cent, the difference is slight and, in practice, is not important. It is very easy to over-oxidize wool with permanganate. Samples bleached 11 and 12 mins. in permanganate were too damaged for further testing. It is noted that 12 overnight bleachings in perborate (192 hours) caused about the same amount of damage as 5 mins. in 0.5 per cent permanganate or 4 mins. in 1 per cent solution.

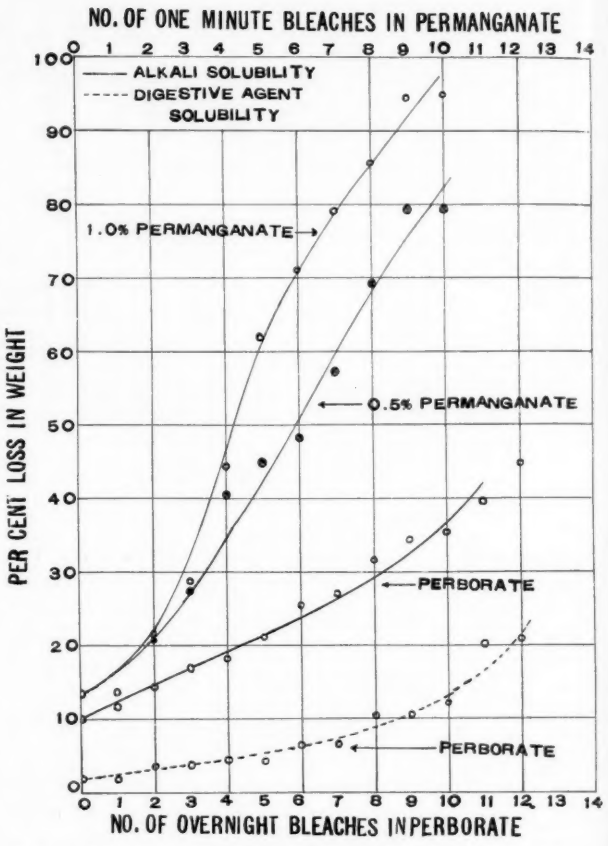


Fig. 1—Solubility of Wool in Dilute Alkali and Enzyme Digestive Bath after Bleaching with Perborate and with Permanganate.

Samples bleached for 2 min. in 1 per cent permanganate and apparently in good condition became slippery when placed in a perborate bath overnight, and after removing the brown discoloration with bisulfite and acetic acid the wool dried very stiff and yellow. The cloth had partially dissolved and was about the consistency of cheesecloth. Thus wool, apparently in good condition, had become so sensitive to alkaline solutions through previous treatment with permanganate that the mild alkali effect of a sodium perborate bleach was sufficient to damage it.

The solubility in a neutral digestive agent of samples bleached in perborate is also shown in Fig. 1. Although new wool was not appreciably affected by digestion, samples which had been oxidized appeared susceptible to damage by enzyme action, as has been suggested by previous workers.[4] Samples having a solubility of 10 per cent or more were noticeably damaged and altered in appearance after removal from the digestive bath.

(2) Alkali Build Up in Perborate Bleaching Baths

Table 2 gives pH values and active oxygen content in terms of 0.092 N. $Na_2S_2O_3$ for 25 ml. samples of the perborate baths.

TABLE 2
pH Values and Active Oxygen Content of Perborate Baths

Time (Hours)	*Start of Period*		*End of Period*	
	pH	*Ml. 0.092 N $Na_2S_2O_3$*	*pH*	*Ml. 0.092 N $Na_2S_2O_3$*
		*1 Oz. Perborate/Gal.**		
16	9.7	20.9	9.6	11.3
32	9.7	21.2	9.6	12.5
48	9.7	21.6	9.7	9.5
64	9.6	18.5	9.7	10.1
80	9.6	23.2	9.7	12.9
96	9.7	20.9	9.7	10.2
		*2 Oz. Perborate/Gal.***		
16	9.6	44.0	9.6	22.3
32	..	..	9.7	16.9
48	..	..	9.7	8.6
64	..	..	9.7	7.1
80	..	..	9.7	4.4
96	..	..	9.6	3.0

*Perborate added after each 16 hour bleaching period.
**No perborate added after each bleaching period.

No appreciable difference in rate of decomposition and pH values was obtained when wool samples were present in the solutions. Since there was no increase in pH after 96 hours, it is believed that the theory of alkali accumulation, under these conditions, resulting in damage is untenable. The buffering effect of the borax formed according to the above equation is apparently sufficient to take care of the small amount of alkali released so that no increase in pH is obtained. In actual practice a large percentage of alkali formed would be absorbed on the wool garments and removed with them, thus preventing an excessive pH increase with continued use.

(3) Effect of Reducing Agents on Wool

Solubilities in dilute alkali and in enzyme digestive baths of samples subjected to reducing treatment are given in Table 3.

These samples, with the exception of those treated with formaldehyde sulfoxylate in the absence of acid, were apparently in good condition and had no harsh feel after removal from the solutions and drying. These data show that wool is not damaged to any extent by treatment with hydrosulfite or bisulfite under the conditions of the test and so far as alkali solubility and enzyme digestion determinations can detect such damage. Formaldehyde sulfoxylate with 1 per cent acetic acid gave somewhat higher alkali solubility values, while in the absence of acetic acid the samples were so severely damaged it was considered unnecessary to determine alkali solubility values.

The iodine absorption values listed in Table 4 parallel the results of the alkali solubility tests and cystine contents very closely.

After standing 12 days in a moist condition iodine absorption values for specimens otherwise treated in the same way were all slightly lower indicating that oxidation was occurring to some extent under these conditions. If it is assumed that iodine absorption under the conditions specified is a function of the amount of cystine produced during reduction, it would appear that the cystine content should decrease in the same proportion. That this is approximately the case, although conditions for determining cystine content tend to neutralize the effect of the reducing agents, is shown by the following comparison:

TABLE 3
Effect of Reducing Agents on Wool

Time (Min.)	*pH*	*1.5% Hydrosulfite: Alkali Solubility (% Loss in Wt.)*	*Solubility in Digestive Agent (% Loss in Wt.)*	*Cystine Content (%)*
Original	5.3			
10	5.4	14.6	1.6	
20	5.4	13.1	1.4	
30	5.5	14.5	1.6	
40	5.5	13.6	1.9	
50	5.6	13.9	1.4	
60	5.7	14.7	1.7	10.8
		1.5% Bisulfite in 1% Acetic Acid		
Original	3.8			
10	4.2	13.6	0.9	
20	4.4	15.3	0.7	
30	4.5	15.2	0.9	
40	4.6	14.2	0.5	
50	4.7	15.5	0.5	
60	4.7	14.9	0.9	6.7
		1.5% Formaldehyde Sulfoxylate in 1% Acetic Acid		
Original	3.7			
10	3.8	15.9	0.4	
20	3.8	21.5	0.5	
30	3.8	25.4	0.5	
40	3.8	25.8	0.3	
50	3.9	26.3	1.0	
60	3.9	26.6	0.8	5.7
		1.5% Formaldehyde Sulfoxylate, No Acid		
Original	9.3			
10	8.7			7.7
20	8.0			
30	7.6			
40	7.4			
50	7.3			
60	7.2			
Blank		11.6	0.3	11.5

TABLE 4
Iodine Absorption Values of Specimens Reduced for 60 Minutes

Sample	*Ml. $Na_2S_2O_3$*	*Blank Minus Sample*	*Untreated Wool Minus Sample*	*Iodine Absorption Value**
		(a) Immediately After Reduction		
Blank	19.20	...	...	...
Conditioned Wool...	14.66	4.54	...	7.39
Hydrosulfite	14.04	5.16	0.62	8.41
Bisulfite	13.15	6.05	1.51	9.86
Sulfoxylate	10.76	8.44	3.90	13.74
		(b) After Standing 12 Days		
Blank	21.25	...	...	...
Conditioned Wool...	16.88	4.37	...	7.11
Hydrosulfite	16.86	4.39	0.02	7.15
Bisulfite	15.90	5.35	0.98	8.71
Sulfoxylate	14.19	7.06	2.69	11.51

*Iodine absorption value $= \frac{V\ (0.1\ N\ Na_2S_2O_3) \times 1.27}{W}$

	Loss in Cystine Content	*Gain in Iodine Absorption Value*
Hydrosulfite	0.7%	1.0
Bisulfite	4.8%	2.5
Sulfoxylate	5.8%	6.4

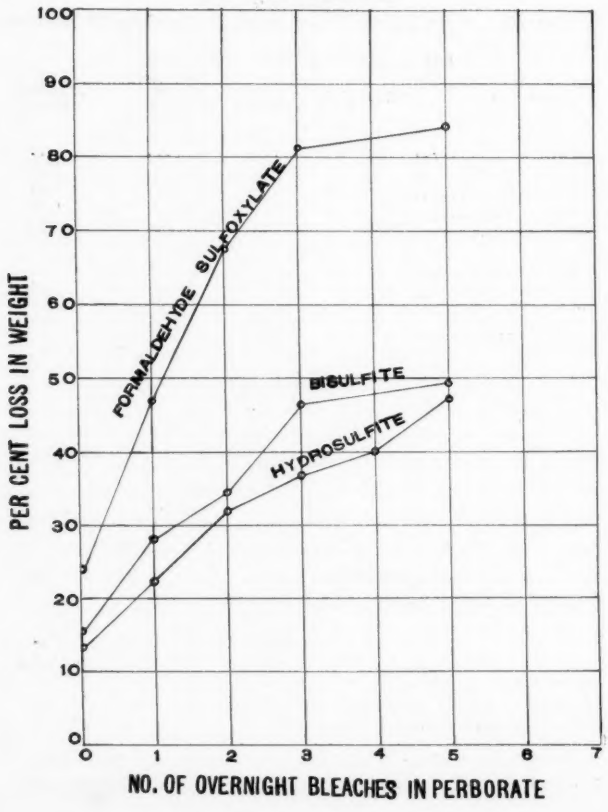
Samples reduced in bisulfite and hydrosulfite solutions for 60 min. gave negative tests for sulfhydryl groups with

an alkaline nitroprusside solution. Positive tests were obtained with samples reduced in formaldehyde sulfoxylate indicating that formation of this grouping increased susceptibility to damage with alkaline solutions. After exposure to the atmosphere in a moist condition for several days positive tests were still obtained, there being apparently insufficient oxidation occurring to restore to the original condition giving a negative test.

The cystine content, as determined by the Sullivan method,[3] of samples reduced for 60 min. gives further evidence of the change in structure brought about by reduction, although the value for the bisulfite treatment was somewhat lower than would be expected from the alkali solubility values. In view of the results of Harris and Smith[2] wherein it was shown that oxidized disulfide groups revert to disulfide groups under hydrolysis conditions necessary for cystine determinations, it was assumed reduced disulfide groups would act similarly and further cystine determinations were not carried out.

The pH values show that all of these reducing solutions were acid except the formaldehyde sulfoxylate solution containing no acetic acid. The results with this reducing agent without acetic acid show the severe damage generally encountered when reduction is carried out in a hot alkaline medium. The increased alkali solubility on treatment with an acetic acid solution of formaldehyde sulfoxylate cannot therefore be attributed to an alkaline solution. It is generally held that wool is not damaged by boiling in acid solutions over the pH range found.

Fig. 2—Alkali Solubility of Wool after Reduction Followed by Perborate Bleaching.



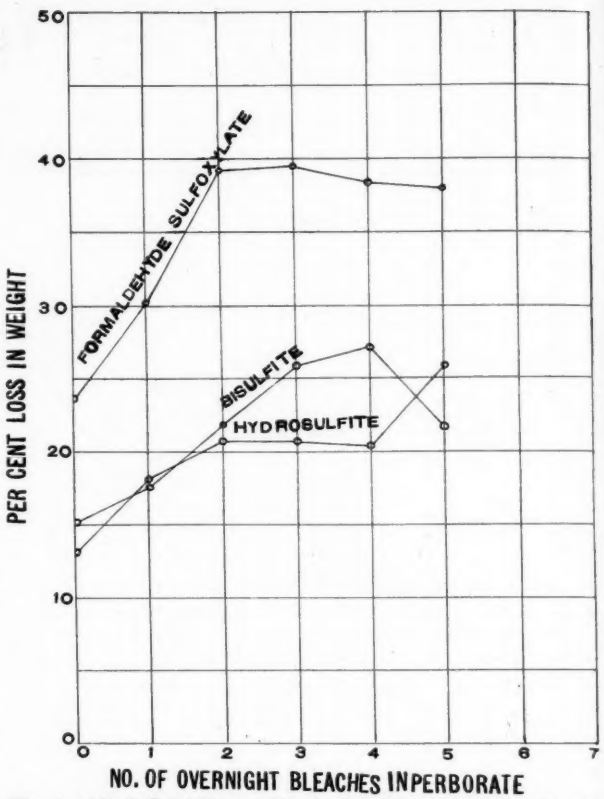


Fig. 3—Alkali Solubility of Wool after Bleaching in Perborate Followed by Reduction.

(4) Effect of Alternating Oxidizing and Reducing Bleaches

Samples subjected to reducing treatment in hydrosulfite, bisulfite with acetic acid, and formaldehyde sulfoxylate with acetic acid for 60 min. were subsequently bleached with perborate-soap solutions for 5 successive overnight periods. Similarly the reverse process was carried out where samples were first bleached for 5 successive overnight periods in perborate-soap solutions followed by reducing treatment for 60 min. with the same reducing agents. The alkali solubilities after these treatments are given in Table 5 and plotted in Figs. 2 and 3.

Higher alkali solubilities are obtained in each instance by first reducing and then oxidizing rather than vice versa. Formaldehyde sulfoxylate has a far greater damaging effect than bisulfite or hydrosulfite. It is apparent from these results that a garment having undergone a thorough stripping action may deteriorate completely when placed in even a mild alkaline oxidizing solution such as sodium perborate.

CONCLUSIONS

One garment in apparently good condition out of several being subjected to a mild alkaline bleaching operation with sodium perborate or to enzyme digestive action may deteriorate completely if previously subjected to vigorous

(Concluded on page 106)

Nylon As A Textile Fiber*

G. P. HOFF**

NYLON is used as the generic name for all synthetic fiber-forming polymeric amides having a proteinlike chemical structure, derivable from coal, air, and water or other substances and characterized by extreme toughness and strength. "Synthetic . . . proteinlike . . . polymeric amides" are the key words in this statement. Nylon may be formed into fibers, bristles, sheets, and other shapes. It follows that nylon does not refer simply to the fibers or yarn spun from a polyamide, but rather to the polyamide itself from which fibers, bristles, sheets, etc., may be formed. In this discussion only nylon in the form of yarn will be considered.

Nylon is the generic name for all synthetic fiber-forming polymeric amides having a proteinlike chemical structure, derivable from coal, air, and water or other substances and characterized by extreme toughness and strength. Structurally nylon may be related to the natural proteins such as silk and wool.

In a test where yarn samples were stretched 4 per cent, held for 100 seconds, and measured 60 seconds after the load was released, nylon showed 100 per cent recovery in comparison to 50 for natural silk, 50 for acetate rayon, 40 for Cordura rayon, and 30 for ordinary viscose rayon. These fibers are also compared in respect to wet and dry strength and water absorption at 60 per cent relative humidity.

Nylon is shown to be crystalline. The melt-extruded filaments as originally produced are capable of easy orientation through stretching with relatively little force required to accomplish a fourfold increase in length. The new length and proportionately reduced diameter are essentially permanent. The oriented yarn is strong, elastic, and tough. It is notable for its ability to take a permanent set through simple treatments with boiling water or steam.

Nylon yarn and fabrics are practically nonflammable. Nylon is physiologically inert and has found use in the form of surgical sutures. It is resistant to enzymes, mildew, molds, and moths.

RELATION OF STRUCTURE TO NATURAL PROTEINS

The recurring groups in a typical synthetic polyamide are typified by a structural formula such as

—OC—R—NH—CO—R
—NH—CO—R—NH—

where R represents several CH_2 groups. These compositions are essentially long, straight-chain molecules or linear polymers. Structurally nylon may be related, to some extent, to the natural proteins such as silk and wool which both possess a common linear structure as Figure 1[1] shows. In the case of silk R is principally methyl and for wool R is exceedingly complicated, as indicated in Figure 2[2]. All of these differ from cellulose, as represented by cotton and wood pulp, in that they contain carbon-nitrogen linkages and do not possess the free hydroxyl groups characteristic of the latter, as Figure 3[3] shows.

From the foregoing it is evident that structurally nylon is much more closely related to the natural proteins than to cellulose. This is equally true of its properties.

PHYSICAL CHARACTERISTICS

The elastic recovery of nylon is remarkable. Figure 4 gives comparisons between the fibers silk, two types of regenerated-cellulose rayon, acetate rayon, and nylon. In this test the samples were stretched 4 per cent, held for 100 seconds, and measured 60 seconds after the load was released.

Figure 5 gives a comparison of average strengths, wet and dry, for the same group of fibers. It will be understood that appreciable variations may exist, depending on the samples chosen.

Figure 6 shows water absorption at a relative humidity of 60 per cent.

MANUFACTURING PROCESS

The comparisons given have been made with drawn or oriented nylon yarn. Prior to the preparation of the yarn it is necessary to carry out condensation reactions in which low-molecular-weight polyamide units are built up to large molecules. With an adequate degree of polymerization a tough, hornlike, nylon polymer is obtained. The molten mass is extruded as a ribbon and is ground to granular form. It has a crystalline structure and melts sharply. It is completely stable and may be stored for any length of time until required for the spinning of the yarn. The flake is melted and then extruded from a spinneret, and the resolidified filaments are collected on a suitable package. Although at this stage the material is crystalline and not amorphous, the molecules have essentially random distribution. Visualize these long-chain molecules within the filaments lying in all directions, twisted and coiled and wrinkled. The x-ray pattern characteristic of this yarn is shown in Figure 7. In this form the fibers have relatively little practical use, and it is necessary to bring about orientation through stretching of the filaments. Relatively little force is required to accomplish a fourfold increase in length. This new length and proportionately reduced diameter are the permanent

*Presented at the Detroit meeting of the American Chemical Society. Reprinted from, and cuts by courtesy of, Industrial & Engineering Chemistry.

**E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.

Figure 1. Structure of Natural Fiber Proteins

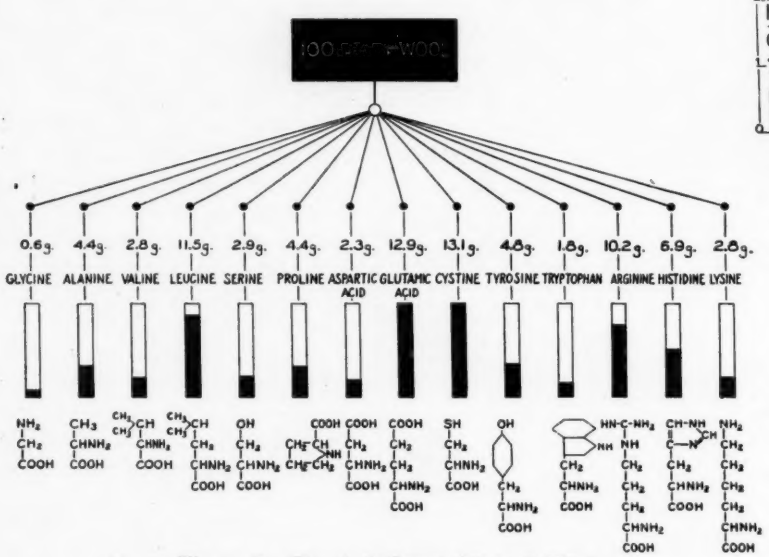


Figure 2. Chemical Composition of Wool

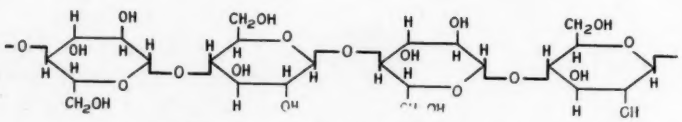


Figure 3. Structure of Cellulose

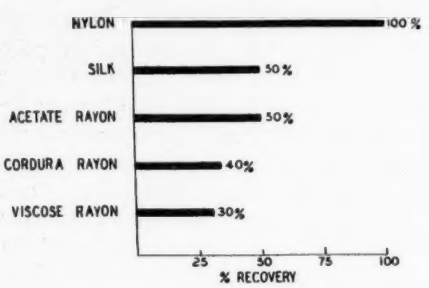


Figure 4. Comparison of Elastic Recoveries with an Imposed Load

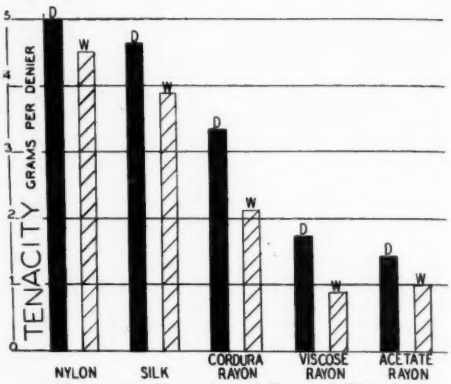


Figure 5. Tenacity of Several Fibers

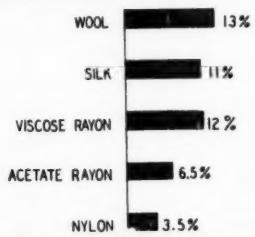


Figure 6. Water Absorption at 60 Per Cent Relative Humidity

Data on silk, viscose rayon, and wool from Wilson and Fuwa (4).

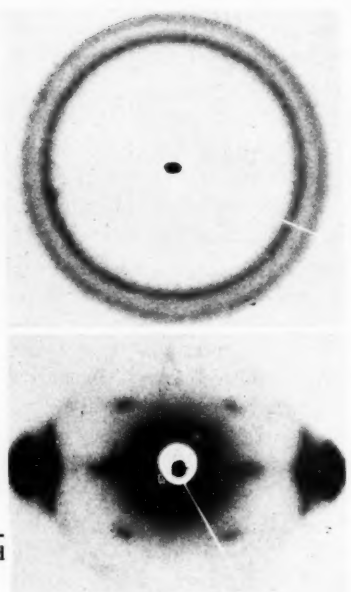


Figure 7. X-Ray Pattern of Unoriented (above) and Oriented Nylon Yarn

attributes of the stretched or drawn yarn. In other words, although the yarn will undergo slight changes in dimension with variations in its moisture content and will shrink a few per cent the first time it is put in hot water, nevertheless it is stable in its drawn form and will not return to the undrawn, disoriented state. Orientation is shown in Figure 7 as a result of this drawing of the filaments. The drawn yarn is now strong, elastic, and tough, and shows the characteristics described above.

NYLON IN FULL-FASHIONED HOSIERY

The principal use for nylon so far has been in full-fashioned hosiery. In addition to the requirements imposed on the yarn by the wearer of the hose who expects beauty, comfort, and long service, there are additional requirements imposed by the knitting, processing, and dyeing steps in hosiery manufacture.

Full-fashioned stockings are shaped to fit the leg. Such stockings are knitted flat, then seamed down the back

(Right) First Step in the Manufacture of Nylon Yarn Begins in This Giant Vessel, Set in the Floor of the Plant at Seaford, Del.

Courtesy du Pont Company

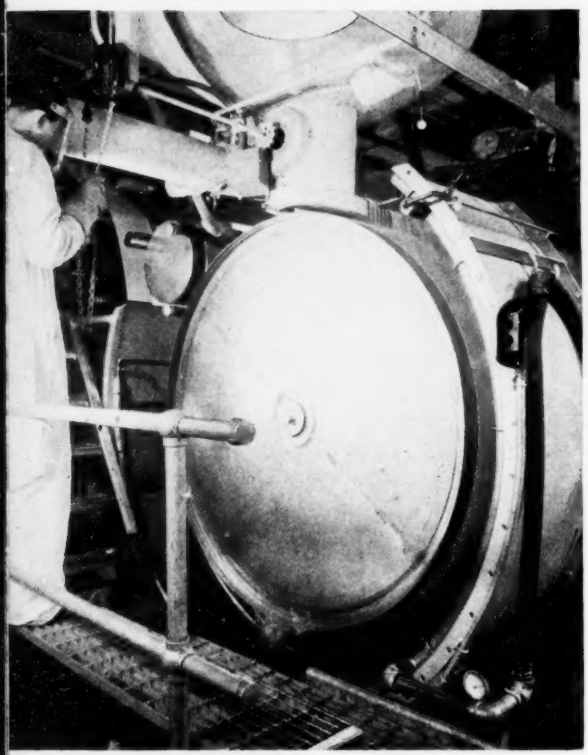
(Below, left) One of the Ingenious Instrument Panels Watching Over the Manufacture of Nylon Yarn; Precision Is Maintained by Control Lights, Chimes, and Varicolored Lines Traced on Charts Which Record the Operations

(Below — right) This Battery of Metal Canisters Contains Nylon Chips, about to Be Transformed into Yarn; Called "Blenders," They Mix the Material to Ensure a Uniform Product

around the heel, bottom, and to the toe. The leg is narrowed by dropping stitches as the knitting progresses down the leg.

Knitting is customarily done on two machines. First the leg, including the hem or welt, and the heel are knit on the legger. The needle bar of a full-fashioned hosiery machine has from thirty to forty-four needles per inch, each of which must be in perfect alignment. The yarn supply is at the back of the machine, the thread being delivered through various guides and mechanisms to the needle bar. One of the requirements of a satisfactory stocking is uniformity of stitch. Experience has shown that for best results the yarn should be knit wet; so in its travel to the needles the yarn passes over wicks or under guides immersed in water. Since full-fashioned hosiery machines were designed primarily to process natural silk, it was necessary to adapt nylon to this same equipment.

Commonly, only the legs are knit on the machine just described, the feet being knitted into the leg on a separate machine of the same type. To transfer the knitted stocking leg from the legger to the footer, an operation known as topping is necessary. Each loop of yarn is removed by hand from the knitting needles of the legger and trans-



Courtesy du Pont Co.

(Left) Nylon Polymer Is Extruded in Ribbon Form on This Huge Casting Wheel

The polymer is first seen as a molten mass, but quickly solidifies and resembles ivory; in later operations it is chopped, melted, and extruded again as filaments.

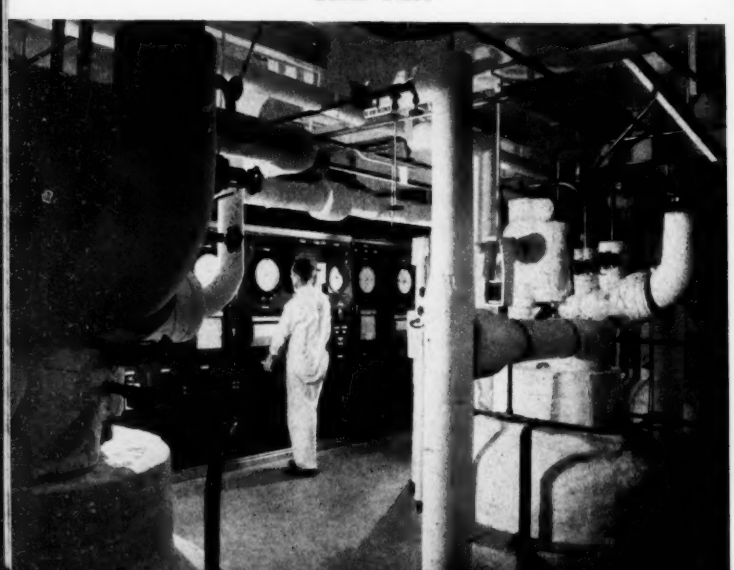
(Right) Nylon Flake Pours from the Hoppers

ferred to those of the footer. The knitting needles are attached to needle bars which are removed from the machines with fabric attached. For ordinary size stockings the needle bar is 14 inches long. The footer continues the knitting without leaving any line of demarcation between the leg and foot. As the knitting continues on the foot, reinforcing threads are introduced to increase the wear of sole and toe. At this point the stocking has the appearance shown in Figure 8 (center). Next the seams must be sewn to form the feet and to close the stockings.

(Continued on page 105)

Figure 8. Appearance of Gray Stocking Prior to Looping and Seaming (center); (right) Nylon Stocking Dyed Like Silk or Other Fibers and Shaped on Form; (left) Nylon Stocking after Being Placed on Form and Subjected to 5 Pounds Gage Pressure before Dyeing

Autoclaves in the du Pont Nylon Plant, Where Polymerization Takes Place



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FEBRUARY 17, 1941

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CALENDAR OF COMING EVENTS

Meeting, New York Section, Swiss Chalet, Rochelle Park, N. J., February 28, 1941. Motion picture "Color Symphony of Our Great West" will be presented by Werner von Bergen. Informal dance will follow.

Meeting, Philadelphia Section, Penn Athletic Club, March 14, 1941.

Spring Meeting, Piedmont Section, George Vanderbilt Hotel, Asheville, North Carolina, April 19, 1941. (Note change in date from April 12.)

Annual Meeting and Convention, Carolina Hotel, Pinehurst, N. C., Oct. 31, Nov. 1, 1941.

Screen Printing Cotton Table Damask*

THE purpose of this paper is to describe briefly the screen printing of cotton table damask as carried out at the Rosemary Manufacturing Company. Limitations of time preclude any attempt to give complete details, however, at the conclusion, I will endeavor to answer any questions regarding the process.

The woven goods are delivered to the finishing plant two inches over finished width and are prepared for printing as follows: They are first singed, then mercerized with 44 degree Twaddle caustic soda, washed, soured, and run into the kier where they are given a four hour pressure boil with caustic soda and an assistant. This boil is followed by a one hour running wash to remove the caustic liquors. The goods are then bleached with 1 per cent hydrogen peroxide and 1 per cent silicate of soda, at 180 degrees F., for one hour, pulled from the kier, washed in rope washers, drawn out on a water mangle and opened to full width, dried and tentered to one inch over finish width and taken from the tenter in one thousand yard units.

The goods are then taken to the dyehouse and pad dyed, at 200 yards per minute, an eggshell ground, in most cases with Indigosols. If dyed with Indigosols the godos are taken to the jig, the color fixed with sulfuric acid, washed, soaped, washed, and tentered to one inch over finished width. It might be stated here that thruout our processing one thousand yard units are used and the goods always tentered to one inch over finished width.

The cloth is now prepared for the actual printing. In the print shop four tables are employed as a unit. The tables are 32 yards long and 72 inches wide. The table top is covered with 5/8 inch felt on top of which is placed a back grey of eighty inch sheeting. Along the right hand side of the table runs a metal straight edge with adjustable stops. The exact position in which the screens are placed upon the cloth is controlled by these stops and adjustable thumb screws on the screen. The goods are pinned to a penciled straight line on the back grey. Once the stops and thumb screws are properly adjusted for each screen and each position, accurate registering of the pattern is assured when the goods are properly pinned to the table. To produce good work, accurate adjustment of the stops, screens, and careful pinning of the cloth is essential. Prior to the actual printing of the cloth a strike off is made, and if all is well, the printing proceeds. Thirty-two yards of cloth are drawn from a thousand yard roll placed before the table, cut and pinned in position. The screen is placed on the cloth in the first position, the color poured onto the screen and pressed into the cloth by means of the squeegee. The squeegee has a 3/8 inch by 1½ inch rubber blade. Four passes are made across the cloth, the screen lifted and placed in the next position. At Rosemary a cut line is printed between each table top and if imperfections occur we then place in a napkin screen with six napkins to the screen this then utilizes all good cloth possible. After the first color has been printed the same operation is carried out for the second, third or fourth colors, depending upon the number employed for each pattern. A different screen, of course, is used for each color. A space of one stop is allowed between the printing of each color, that is, when the first screen reaches the third position, the second color is printed in the first position and so on. Each screen is handled by two men and the operation proceeds continuously along the table and then from one table to the next. Following the completion of each piece, the pins are removed, the goods raised above the table by means of a rope and pulleys and suspended above the table to allow the colors to dry. The drying is speeded by circulating air. By employing four tables as a unit and five hanging lines above each table, the work may proceed continuously.

At this point it might be well to describe the screens. They are made of silk bolting cloth held in a wooden frame. A separate screen is made for each color in the design, and the part a particular color plays in the design is reproduced photographically by printing directly upon the bolting cloth which has been treated with sensitized gelatine. Everything but the design is blocked out, with alkali resisting paint, the unpainted gelatine washed out and the bolting cloth is ready for use. We are at present experimenting with metal screens and they appear to have definite possibilities for this type work.

At Rosemary, Indigosols and Pharmasols are chiefly used, although sulfurs and pigment colors have been printed. The colors is prepared in five gallon lots which has been arbitrarily adopted as the most convenient unit. Gum tragacanth is used as the thickening agent, and caustic soda, ammonium vanadate and sodium chlorate used with Indigosols. The sulfurs are a purified liquid type, thickened with tragacanth and reduced with polysulfides. Pigments are prepared with commercial thickeners and the viscosity of the paste controlled with water and naphtha solvents.

*Presented by Piedmont Section, Inter-sectional Contest, Annual Meeting, New York, N. Y., October 18, 1940.

Formulas are attached to the samples on display and those interested may examine them at the conclusion of the paper. That color in the design containing the least amount of coloring matter is always printed first and that containing the most printed last. The purpose being to reduce to a minimum the contraction of the cloth due to the alkalies in the paste and to produce as faithful a reproduction of the original design as possible.

After drying the thirty-two yard pieces are sewed into one thousand yard lengths and, in the case of Indigosols and Pharmasols, run thru an acid ager. Equal parts of acetic and formic acids are injected with steam at both ends of the ager. The ager, built at Rosemary, is the same length as an ordinary roller printing ager and is copper lined. The copper lining, brass carrier rolls and all exposed parts are painted monthly with an acid resisting paint. Two hundred five yards of cloth are in the ager at one time. Variable speed controls enable operation at anything from ½ to 132 yards per minute.

Following ageing, any prints containing Indigosol Blues or Greens are passed thru sulfuric acid and sodium nitrite in the acid squeezer, to insure complete development of the color. They are then washed at 110 degrees F., soaped, washed at 140, washed cold, opened to full width on a water mangle, tentered to one inch over finished width, and calendered. The cloth is passed thru one nip on the calender for the purpose of straightening the pattern. The finished cloth is inspected and shipped to the cutting department for making up and marketing. As stated at the beginning of this paper no attempt has been made to go into detail, but rather to describe the actual practical operations. The short motion picture that follows may give a somewhat better idea of these operations; however many practical difficulties were encountered in making the picture, and if some of the shots are not too clear, please bear with me. At the conclusion I shall be glad to discuss the samples and answer your questions.

NOTE: Wm. A. Wolhar, who presented this paper for the Piedmont Section, will loan the motion pictures to any Section desiring to show them. The film is 16 m.m., 700 feet, and requires about 25 minutes to show. Reading time of paper about 9 minutes. Address Mr. Wolhar at 537 Roanoke Ave., Roanoke Rapids, N. C.

A Simple Apparatus for Testing Flameproofed Fabrics*

EMILY W. AKIN and ALFRED R. MACORMAC**

INTRODUCTION

THE interest of the authors in the subject of flameproofed material was aroused by the occurrence of a number of fires in clothing and draperies which resulted in severe burns to a number of people.

The viewpoint emphasized in this study is that of the ultimate consumer. Our object is to investigate the possibility of flameproofing garment and other similar fabrics, and in the development of a simple apparatus whereby the ordinary retail merchant or householder could determine the fire resistant properties of a fabric.

It was found that a number of concerns are at present flameproofing fabrics and that a number of formulas of flameproofings are available. Several different classes of chemicals may be used. Most of the flameproofing treatments at present in use are used on heavy duck, canvas, or similar fabrics. They impart a hard, boardy feel to the cloth which would be objectionable in a garment. Recently the use of sulfamic acid and its ammonium salt has provided a fireproofing agent which does not stiffen the fabric or change its finish. This treatment is resistant to dry cleaning but not to washing. It should be useful on clothing as soon as the consumers' demand creates a market for flameproofed garments. Recently a few flameproofed garments have been placed on the market. In the future this type of fabric will meet an increasing demand. Hence this simple apparatus for testing flameproofed fabrics should be of wide interest.

GENERAL DISCUSSION OF FLAMEPROOFING

1. Brief History of Flameproofing Agents

Flameproofing is generally considered a comparatively new field, but it has been a source of interest for several centuries. Mention of the flameproofing of textiles occurs as early as 1638, when Nikolas Sabbattini recommended that clay or gypsum be mixed with the color used in painting theaters and scenery as a means of fire prevention.[1]

There is a note under the heading, "Early Science at Oxford," which states, "Sept. 16th, 1684; Merchant

*Presented at the Symposium on Evaluation of the Properties of Finished Textiles, Annual Meeting, New York, N. Y., October 18, 1940.

**Alabama Polytechnic Institute.

Wayts' account of his piece of Incombustible cloth was read."[2]

Jonathan Wild of England was granted a patent in 1735 for a flameproofing mixture composed of alum, ferrous sulfate, and borax.[1]

In 1821 Gay-Lussac published the results of an investigation in which he found that ammonium phosphate, equal parts of ammonium chloride and ammonium phosphate and equal parts of ammonium chloride and borax were effective.[1]

In 1859 Versmann and Oppenheim reported that five of the salts and mixtures tried had practical value; ammonium phosphate, sodium-ammonium phosphate, ammonium phosphate and ammonium chloride mixture, ammonium sulfate, and sodium tungstate.[1]

In 1900 Whipple and Fay reported that of the many salts tried ammonium phosphate was found to be most effective.[1]

In 1912 Perkin reported that stannic oxide was a permanent fireproofing agent for cotton goods.[1]

In 1922 Kling and Florentine stated that a solution of borax and borax acid in a 6:5 ratio was the most suitable of many agents tried.[1]

In 1930 Ramsbottom and Snoad reported that borax and boric acid in a 7:3 ratio was preferable to the proportions suggested by Kling and Florentine.[3]

In 1932 Chesneau suggested that the addition of sodium phosphate to sodium tungstate would prevent crystallization.[4]

In 1934 Brosman reported that compounds of Fe, Cr, Pb, and Cu appeared to accelerate the rate of burning. Mixtures of ammonium salts, borax and borax acid were found to be effective.[5]

In 1935 The National Bureau of Standards suggested the use of sodium tungstate and ammonium phosphate.[1]

In 1938 Cuprey reported a new process for the production of sulfamic acid to be used as a fireproofing agent. Sulphamates do not cause stiffening, and are not removed by dry cleaning, two factors which are desirable in a fire proofing agent.[6]

Many compounds and mixtures of compounds have been suggested, but only a very few can be mentioned here. A more complete account may be found in the "Bibliography of Flameproofing" compiled as a preliminary study which was published in the "American Dyestuff Reporter" 29, 418-20, 445-51 (1940).

2. Classification of Treatments Which Impart Flameproof Qualities to Fabrics

These are classified as follows according to the means by which combustion is retarded:

(a) Materials which envelop the fibers, preventing oxygen from coming in contact with the fibers.[4, 10]

(b) Compounds which upon ignition leave a large amount of ash.[11]

(c) Salts which at a comparatively low temperature fuse or are converted into fusible bodies.[11]

(d) Compounds which evolve non-inflammable gases.[4, 10, 11]

(e) Compounds which act as miniature automatic sprinkler systems in that moisture is given off when the chemicals melt.[9]

(f) Less combustible fibers incorporated with fibers that are easily combustible.[10]

(g) Combinations of two or more of the above.[9, 10, 11]

3. Home Method for Flameproofing Fabrics

A method, which has been suggested by the United States Department of Agriculture, for the flameproofing of fabrics in the home consists of a solution of 7 ounces borax, 3 ounces boric acid, in 2 quarts of hot water. The fabric is immersed in this solution, dried, and ironed.

In addition, this method is said to protect the fabric from the injurious action of acidic sulphur dioxide gases found in the air where coal or other sulphur-containing fuels are burned. Since the chemicals are soluble in water, they are removed from the fabric by wetting. This solution does not prevent scorching or charring of the fabric but does prevent it from bursting into flame and spreading the fire. Flaming is prevented because the chemicals melt and seal off the fibers, and at the same time moisture is given off which helps to prevent flaming. The fabric is not injured by this solution.[7, 8, 9]

PRESENT METHODS OF TESTING FLAMEPROOFED FABRICS

1. Review of Testing Methods

(*a*) *The National Bureau of Standards Vertical Burning Test.*

A specimen 2 inches wide by 12½ inches long is clamped in a vertical position with the lower end free so that a 12 inch length is exposed for 12 seconds to a luminous flame 1½ inches long from a ⅜ inch Tirrill gas burner, the air ports of which are completely shut. To protect the specimen from drafts the apparatus is enclosed in a sheet metal shield 14 inches wide, 12 inches deep, and 30 inches high, open at the top and provided with a vertical sliding glass front. Sufficient room is left at the bottom of the front to allow manipulation of the gas burner used in igniting the specimen.

A record is made of the time from the application of the burner flame until flaming, if any, ceases, and the length of char is measured.[12]

(*b*) *Underwriters' Laboratories Flammability Test.*

The apparatus consists of a sheet iron stack, 12 inches square, 7 feet high, and supported 1 foot above the floor on legs. The specimen, 7 feet long by 5 inches wide, is hung from a bar at the top of the stack so that the bottom of the specimen is 5¾ inches above the top of a ⅜ inch Fletcher gas burner. With a gas pressure

of 108 millimeters the burner flame is made 11 inches high by adjusting the air supply. The specimen is exposed for 2 minutes. A record is made of the time the specimen ignites and the time that flaming and glowing cease. Measurements are also made of the distance from the tip of the burner flame to the top of the charred area.[12]

(*c*) *Freeman Stove Pipe Test.*

A 5 inch brass tube 24 inches long lined with asbestos paper has eight ¾ by 1½ inch slots at the bottom for admission of air. Six 24 by 3 inch specimens spaced ¾ inch on centers are hung from a rack placed on top of the tube. The samples are ignited by burning 1 ounce of excelsior at the base of the apparatus. The per cent of the initial weight burned is calculated and used as the criterion of performance.

This test was discarded because of its severity, and a less severe exposure substituted.

Modified Freeman Stove Pipe Test.

The same stove pipe apparatus was used with a Fletcher radial gas burner (5 inch outside ring diameter) having a 4 inch flame. Three specimens of the same size and hanging as in the original Freeman test are exposed for 15 seconds. The per cent loss in weight is again used as a criterion of performance and is found to be much lower than when using strips and the more severe exposure.[12]

(*d*) *Whipple-Fay Burning Test.*

The apparatus consists of a small alcohol lamp having a glass chimney 8 inches long and 2 inches in diameter. The specimen, 1 inch wide and 8 inches long, is folded over for ½ inch at the top and hung from across the top of the chimney, the bottom of the specimen projection ½ inch into a 2 inch long flame from a ¼ inch diameter arc. The specimens are left in the test flame for 1 minute, then withdrawn, and a record is made of any independent flaming and the length of char.[12]

(*e*) *British Standards Institution Test.*

The specimen, 6 by 6 inches, is spread over a wire grid stretched on a 6½ inch square metal frame so that its major plane is at an angle of 45 degrees with the horizontal. The frame rests on vertical supports such that (1) the center portion of the specimen is not shielded from the flame, (2) air necessary for combustion is freely accessible, and (3) the progress of the test can be observed. A flat bottomed cup, 11/16 inch external diameter, ⅝ inch internal diameter, and 9/32 inch high, is placed on a cork and supported so that the center of its base is 1 inch vertically below the center of the lower face of the specimen. The specimen is exposed to the flame from 0.3 milliliter of absolute alcohol in the metal cup. (Under normal conditions the flame lasts about 45 seconds.) A record is made of the time of flaming and glowing after the alcohol flame burns out, and measurements are taken of the charred area.[12]

(*f*) *Fold Test.*

A 12 by 15 inch specimen is folded so that there are five folds of cloth, each about 3 inches wide. The folds are suspended from a clamp so that the bottom of the specimen is ¾ inch above the burner for 2 minutes. The time of glow and the weight of the specimen, before and after test, are recorded. This test was suggested by a similar test used by the Underwriters' Laboratories and gives an idea of the hazard of the material when hanging in folds. The loss in weight varies with the treatment, fabric, and room draft conditions at the time of the test, as most of the combustion takes place as glow.[12]

(*g*) *Ramsbottom and Snoad Test.*

Cotton fabric weighing 4 ounces per square yard having 110 warp yarns and 100 filling yarns per inch was used. The flame tests were made on strips 1 inch wide by 18 inches long held vertically in a box perforated at top and bottom. A flame 1 inch long from an orifice 0.02 inch in diameter was played across the lower end of the strip until it was burning evenly, whereupon the flame was withdrawn. The rate of flaming was determined by observation of the time required for the fire to travel over a 12 inch length between marks 3 inches and 15 inches from the lower end.[1]

(*h*) *Match-Flame Ignition Test.*

A specimen 2 inches wide is suspended vertically with the long edge in a horizontal direction. Lighted safety matches are applied to the lower edge, and the susceptibility to ignition is determined.

A similar match-flame test is used by inspectors of the District of Columbia Fire Marshall's Office. To be acceptable a fabric must not burst into flame when the burning match is held along a vertical edge.[1]

(*i*) *Horizontal Rate-of-Burning Test.*

A specimen about 2¾ inches wide and 15 to 30 inches long is cut from a sample and placed with its surface horizontal between two clamps 2 inches apart, supported on a steel frame. The specimen is ignited at one end with a small flame from a Bunsen burner and allowed to burn freely over the entire length in the still air of the laboratory. The time for the flame front to travel over a definite length is measured, from which the rate of burning in inches per minute is calculated. This is used chiefly to compare rates of burning of untreated fabrics.[1]

(*j*) *Gustav Durst's Method of Testing of Flame Resistance of Textiles.*

(1) Strips 5 by 100 centimeters are used, marked each 10 centimeters. The strips are held vertically by 2 clamps at the 50- and 100-centimeter marks, the 0 mark is 2 centimeters above the tip of the Bunsen burner, the flame of which is adjusted to a length of 10 centimeters. A thermometer, the bulb of which is at the 30 centimeter mark, should read 85 degrees Centigrade. The results are given in centimeter lengths of the strips carbonized.

(2) Ignition by Flying Sparks. Above an electric hotplate, 3 rings are spaced 9 centimeters apart. The fabric to be tested is placed on the first and second rings above the hotplate. On the third ring a tin plate is laid. The apparatus is enclosed in a tin shield in which a temperature of 70 degrees Centigrade is maintained. For ignition, a piece of hard coal about 0.3 gram in a glowing condition is laid on the uppermost piece of fabric, allowed to burn through and fall to the second piece of fabric. To be considered flameproof, burning should not continue after the coal has burned through the fabric.[13]

(*k*) *Methods Used at the Office National des Recherches et Inventions for Testing Fireproofed and Fireproofing Products.*

By means of an adjustable arrangement, the center of the sample can be brought to a vertical distance of 25 millimeters from the bottom of a small brass cup of definite dimensions 16 millimeters inside diameter and 7 millimeters high at the edges. To make the test, pour 0.3 cubic centimeters absolute alcohol into the cup, put the sample in place, and light the alcohol. It should burn for 1 minute. After the alcohol has completely burned, the lower surface of the sample is examined. To be considered fireproofed, the sample should not char to any edge of the sample.

For light weight cloth the test is made on 6 samples 6 centimeters by 6 centimeters. These are exposed for 60 seconds to the flame of a Meker burner No. 3 with a supply of gas at full pressure. The upper edge of the flame is 8 centimeters below the sample. The 6 samples are held out flat and paralleled one after the other at distances of about 5 centimeters in a frame inclined at an angle of 45 degrees, protected from air currents and so fixed that the length is at an angle of 45 degrees and the width horizontal.

The combustion of each sample should be limited to the part in contact with the flame, and the part ignited should be extinguished in 3 seconds after the withdrawal of the flame from all 6 samples.[14]

(*l*) *Saadov and Steblor's Method for Testing Fireproofed Cloth.*

A strip 20 centimeters long is folded into four and placed on a wooden board with half the length hanging over. On bringing a Bunsen burner near to the strip, burning should not extend to the board and the part on the board should not char in five minutes. A strip soaked in benzene should not burn or glow after the benzene has burnt away.[15]

2. Observations from Literature and Research Concerning the Methods of Testing

In "The National Bureau of Standards Vertical Burning Test" the Bureau states that among the advantages of this test are: (1) the moderate size of the specimen, (2) short flame which is easily controlled, (3) specimen moves little, since there is only a mild draft, (4) vertical position represents most hazardous position.[1]

When this experiment was performed in the laboratory it was difficult to keep the specimen in the flame. This seemed to be due more to the curling caused by the charring of the cloth than to a draft.

In the "Underwriters' Laboratories Flammability Test" the chief advantage is the strong draft which gives opportunity for the flame to spread. Some of the disadvantages are: (1) large specimen, (2) long flame, which is difficult to keep constant, (3) movement of specimen which makes it difficult to keep specimen in contact with the flame.[12]

In the "Modified Freeman Stove Pipe Test" the per cent loss in weight depends on the type of fabric as well as the treatment so that the performance of a well-treated fabric in this test can not be easily specified.[12]

In the "Whipple-Fay Burning Test" the draft is great and the height of flame is difficult to control.[12]

The "British Standards Institution Test" appears to be better adapted to materials in the form of sheets or boards of appreciable thickness than to fabrics.[12]

The "Fold Test" gives an idea of the hazard of material when hanging in folds. Results of the test depend upon the treatment, fabric, and room draft conditions.[12]

The "Ramsbottom and Snoad Test" seems to be more satisfactory for determining the rate of burning of untreated fabrics than a test for flameproofed fabrics.

The "Horizontal Rate-of-Burning Test" gives good results when used to determine the rate of burning of untreated fabrics, but it is not severe enough to give useful results.

In "Gustav Durst's Method of Testing the Flame Resistance of Textiles" the length of flame is difficult to control.[13]

NEW METHOD OF TESTING FLAMEPROOFED FABRICS

1. A Simple Apparatus for Testing Flameproofed Fabrics

This apparatus is suggested because it is simple enough to be used for demonstrations in textile classes to show whether or not fabrics are flameproofed. It may also be used to compare the rate of burning of various untreated fabrics.

The apparatus resembles a box with the front and top removed. It is constructed of ply board, the inside dimensions of which are 10 inches wide, 10 inches deep, and 30 inches high. A heavier board is used as the base to give strength to the upright sides and back. A removable shelf is placed 10 inches from the bottom (A), supported by ½ inch strips (B). This shelf is made so that it can be removed if it is desirable to lower the flame or to substitute a Bunsen burner or other flame. Another piece of ply board 10 inches by 14.1 inches, in the center of which is cut a 4 inch by 4 inch hole, is

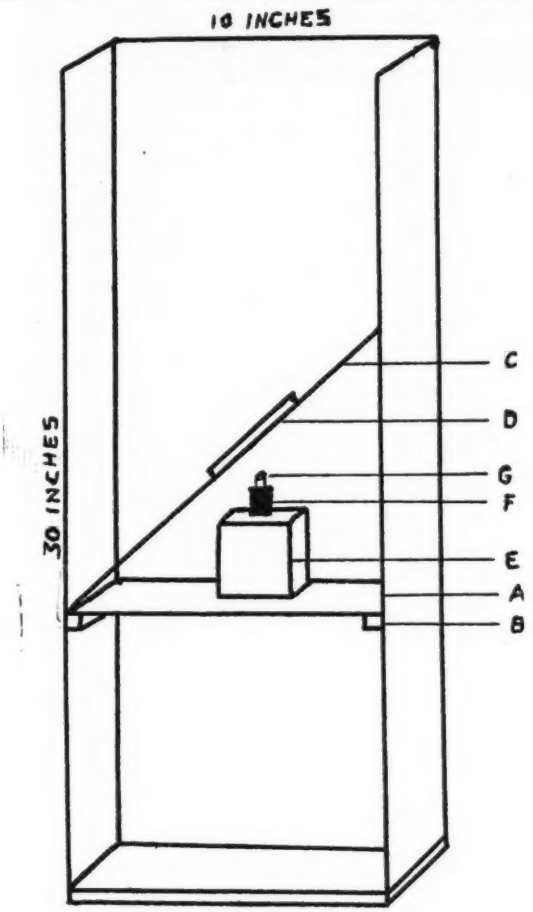


Diagram of Apparatus (Front View)

placed on the removable shelf at an angle of 45 degrees (C). No additional support is necessary to hold this at the correct angle. On the upper side of the inclined plane, at the lower edge of the 4 inch square hole, is placed 4 small nails which hold an embroidery hoop that is 4 inches in diameter (D). This hoop holds the cloth smoothly in place. No experiments were performed to determine the effect of tension on the sample. A block is set on the shelf so that it is 2 inches vertically under the center of the opening on the inclined plane (E). Upon the center of this block a 1 inch cork is placed (F); on this cork is a small, metal, flat-bottomed cup, 5/8 inch inside diameter and 9/32 inch high (G). This arrangement places the bottom of the cup 1 inch from the face of the fabric. A small metal thimble can be used in the place of the metal cup of definite dimensions with fairly consistent results. 0.3 milliliter absolute alcohol is used for the flame. The metal cup is placed on a cork base rather than on a metal base, since 0.3 milliliter absolute alcohol will burn about 1½ minutes if the cup is on a cork base, but 0.3 milliliter absolute alcohol will burn 3 minutes if the cup is on a metal base. The cup should be cooled after each test. If repeated tests are made without cooling the cup, the alcohol will burn 1½ minutes in the first test, 57 seconds in the second test, 50 seconds in the third test, and 45 seconds in the fourth test. If absolute alcohol is not attainable, 95 per cent alcohol can be substituted and consistent results obtained.

To make the test cut 6 samples from at least three different places in the cloth, 6 inches by 6 inches square. Place sample in hoop with the face of the material upward. Measure 0.3 milliliter absolute alcohol and put in the cup. Place hoop containing the cloth in position on the inclined plane so that the face of the material is toward the flame and the warp threads are parallel to the face of the plane. Light the alcohol with a match which has been struck long enough to burn without flaring. The alcohol will have begun evaporating so that it is necessary only to pass the match near the top of the cup for the fraction of a second. Watch for flaming or glowing. To be considered flameproof, no flame should be present on the fabric during the length of time it takes for the alcohol to burn. The charred area should not extend to any edge of the hoop. If flaming does not occur, the shape of the charred area is that of an ellipse; but if flaming does occur, the upper edge of the charred area becomes enlarged due to the upward travel of the flame.

2. Tests Using Bunsen Burner as the Flame

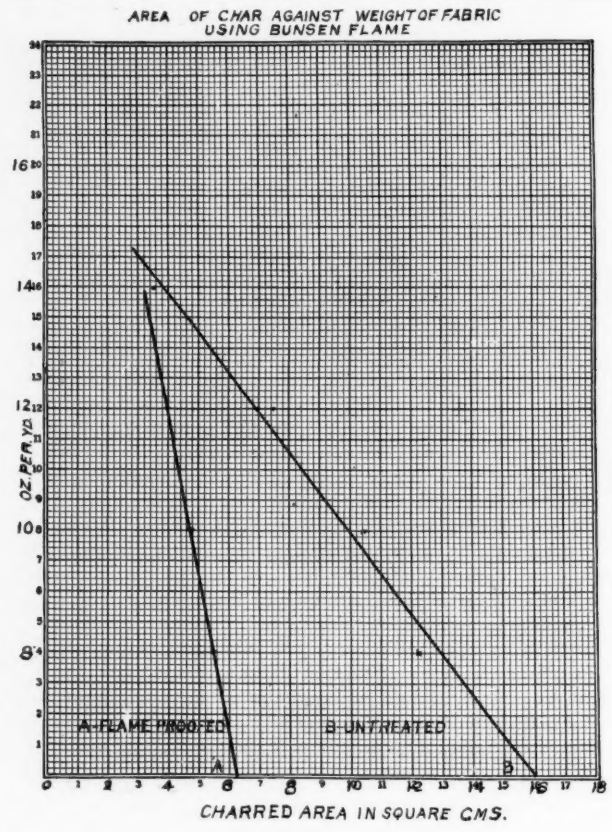
Using the apparatus previously described, experiments were made using a 5/8 inch Bunsen burner. Four weights of untreated fabric (8, 10, 12, and 14 ounce canvas) were used. A 1½ inch luminous flame, obtained by having the gas at full pressure with the air ports completely shut and adjusting the length of flame, was applied for 15 seconds at three different heights from the cloth (1, 2, and 3 inches).

Results:

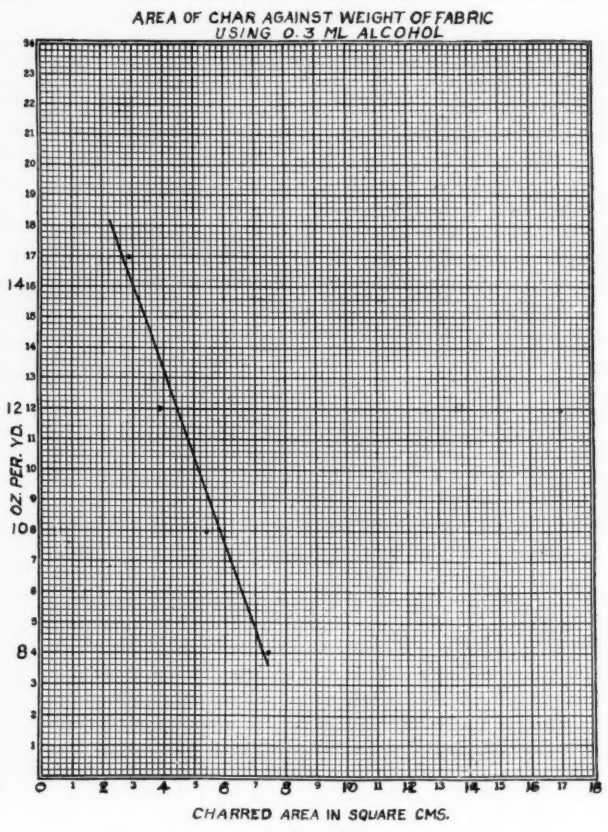
	1 inch from flame Amt. of char	*2 inches from flame Amt. of char*	*3 inches from flame Amt. of char*
8 oz.	3.3 x 4.7 cm. (flamed)	2.2 x 3.1 cm.	1.8 x 2.3 cm.
10 oz.	3.1 x 4.3 cm. (flamed)	1.8 x 2.3 cm.	1.1 x 1.7 cm.
12 oz.	2.4 x 3.4 cm. (flamed)	1.3 x 2 cm.	.9 x 1.4 cm.
14 oz.	1.9 x 2.3 cm. (glowed)	1.1 x 1.8 cm.	Too slight to measure

On different weights of flameproofed fabric using the 1 inch flame only, since the others did not cause flaming on the untreated fabric, the following results were obtained:

	1 inch from flame
8 oz.	Char 2.2 x 3.2 cm. (No flame)
10 oz.	Char 2 x 3 cm. (No flame)
12 oz.	Char 1.8 x 2.8 cm. (No flame)
14 oz.	Not tested since there was no flaming or glowing on the untreated.



Graph I



Graph II

Conclusions:

The length of time for which the specimen is subjected to the heat is so short that it is difficult to obtain consistent results. It does seem to prove that there is a definite relationship between the burning point of a piece of fabric and its weight. The size of the charred area decreases proportionately as the weight of the fabric increases. (Graph I). This may not hold true on fabrics of a different weave such as napped goods.

3. Tests Using Alcohol as the Flame

With the apparatus previously described, experiments were made with different quantities of alcohol under varying conditions. Four weights of untreated fabric (8, 10, 12, and 14 ounce canvas) were tested. Absolute alcohol in quantities of 0.1, 0.2, and 0.3 milliliter was burned in the metal cup which was placed 1 inch below the fabric.

Results:

	0.1 Milliliter alcohol Amt. of char	*0.2 Milliliter alcohol Amt. of char*	*0.3 Milliliter alcohol Amt. of char*
8 oz.	1.3 x 2.3 cm.	2.5 x 3.5 cm. (flamed)	Completely Burned
10 oz.	1.3 x 2.1 cm.	2.4 x 3.1 cm. (flamed)	Completely Burned
12 oz.	1.3 x 1.9 cm.	2 x 2.8 cm. (glowed)	Completely Burned
14 oz.	1.3 x 1.7 cm.	2 x 2.8 cm. (glowed)	Completely Burned

Four weights of flameproofed fabric were subjected to the test using 0.3 milliliter absolute alcohol.

	0.3 Milliliter absolute alcohol
8 oz.	Char 2.6 x 3.6 cm. (No flame)
10 oz.	Char 2.2 x 3.2 cm. (No flame)
12 oz.	Char 1.8 x 2.8 cm. (No flame)
14 oz.	Char 1.4 x 2.4 cm. (No flame)

Conclusions:

0.3 milliliter absolute alcohol should be used since this produced a sufficient amount of heat to ignite a fabric weighing as much as 14 ounces. Results obtained in this test are consistent and reproduceable.

4. Comparison of Tests Made Under Ordinary Atmospheric Conditions with Tests Made Under Standard Conditions

The experiments were made using the simple apparatus for testing flameproofed fabrics.

Under Ordinary Atmospheric Conditions

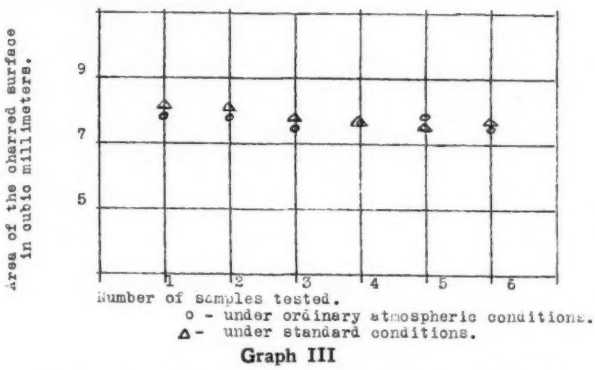
8-oz. untreated fabric	*8-oz. flameproofed fabric*
1. Completely consumed.	1. Char 2.6 x 3.6 cm. (no flame)
2. Completely consumed.	2. Char 2.6 x 3.6 cm. (no flame)
3. Completely consumed.	3. Char 2.4 x 3.4 cm. (no flame)
4. Completely consumed.	4. Char 2.6 x 3.6 cm. (no flame)
5. Completely consumed.	5. Char 2.7 x 3.7 cm. (no flame)
6. Completely consumed.	6. Char 2.6 x 3.6 cm. (no flame)
	Average, 2.58 x 3.58 cm.

Under Standard Atmospheric Conditions (Temperature 70° F., Relative Humidity 65%)

8-oz. untreated fabric	*8-oz. flameproofed fabric*
1. Completely consumed.	1. Char 2.5 x 3.5 cm. (no flame)
2. Completely consumed.	2. Char 2.5 x 3.5 cm. (no flame)
3. Completely consumed.	3. Char 2.6 x 3.6 cm. (no flame)
4. Completely consumed.	4. Char 2.6 x 3.6 cm. (no flame)
5. Completely consumed.	5. Char 2.6 x 3.6 cm. (no flame)
6. Completely consumed.	6. Char 2.3 x 3.6 cm. (no flame)
	Average, 2.52 x 3.57 cm.

Conclusions:

The simple apparatus for testing flameproofed fabrics gives consistent results whether tests are made under ordinary atmospheric conditions or whether under standard conditions. (Graph III).



Graph III

Comparison of Tests Made under Ordinary Atmospheric Conditions with Tests Made under Standard Conditions. 8 ounce flameproofed canvas was tested with the simple apparatus for testing flameproofed fabrics. The apparatus gives consistent results whether tests are made under ordinary atmospheric conditions or whether under standard conditions (70° F., 65 per cent R.H.).

5. Effect of Certain Known Per Cents of Flameproofing Agents on Fabric

Tests were made on 8 ounce canvas with the simple apparatus for testing flameproofed fabrics to determine the degree of flameproofness of fabrics. The following results were obtained:

Untreated fabric: Small flame which spread slowly over the fabric. The entire sample was completely burned.

Treated with 1 per cent flameproofing solution:* Large flame which spread rapidly over the surface of the fabric, but did not make a hole. Flaming ceased when alcohol ceased burning.

Treated with 5 per cent flameproofing solution:* Flame which spread rapidly upward, but did not make a hole. Flaming ceased before alcohol ceased burning.

Treated with 10 percent flameproofing solution:* Average char on 6 samples was 3.4 by 4.8 centimeters.

Conclusions:

If less than the recommended quantity† of flameproofing agent is applied, more flash flaming occurs than is found on the untreated fabric.

SUMMARY

Chemicals for the flameproofing of fabrics and flameproofed fabrics are now on the market. Therefore a suitable method for testing the effectiveness of the flameproofed fabric is needed. In order to meet this need the "Simple Apparatus for Testing Flameproofed Fabrics" is given.

The flameproofing of fabrics has been of interest for several centuries, but from a commercial viewpoint it is a comparatively new field.

The treatments which impart flameproof qualities to fabrics are classified according to the means by which combustion is retarded.

A simple home method for flameproofing fabrics consists in the use of a solution of borax and boric acid in water.

The methods now in use for testing flameproofed fabrics are: (1) The National Bureau of Standards Vertical Burning Test, (2) Underwriters' Laboratories Flammability Test, (3) Freeman Stove Pipe Test, (4) Whipple-Fay Burning Test, (5) British Standards Institution Test, (6) Fold Test, (7) Ramsbottom and Snoad Test, (8) Match-Flame Ignition Test, (9) Horizontal Rate-of-Burning Test, (10) Gustav Durst's Test, (11) National des Recherches et Inventions Test, (12) Ssadov and Steblor Test.

Each of the test methods show advantages and disadvantages.

"The Simple Apparatus for Testing Flameproofed Fabrics" is described. This apparatus gives consistent and reproduceable results.

Tests using the Bunsen burner as the flame show that the charred area on a fabric decreases proportionately as the weight of the fabric increases.

Tests using alcohol as the flame show that it is necessary to have 0.3 milliliter absolute alcohol to produce a flame sufficient to ignite untreated cloth.

Tests made under ordinary atmospheric conditions are comparable with tests made under standard conditions, 70 degrees Fahrenheit and 65 per cent relative humidity.

Flameproofed fabrics should have the recommended per cent of flameproofing agent applied or there is more danger from flash flaming than there is when the fabric is untreated.

ACKNOWLEDGMENTS

We wish to thank the following persons and firms for their assistance in carrying on this work: Walter T. Schreiber, Chemist, U. S. Department of Agriculture; Dr. Otto Morningstar and Robert Reardon of the West

*Solution A, Fire Retardant Salt, E. I. du Pont de Nemours & Co.

†A ten per cent solution is recommended.

Point Manufacturing Company; Dr. Louis A. Olney, Lowell Textile Institute; the E. I. du Pont de Nemours and Company; and the Price Fire and Waterproofing Company, Poughkeepsie, N. Y.

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MEETING, PHILADELPHIA SECTION

THE last meeting of the Philadelphia Section was held at the Penn Athletic Club on Friday night, January 17, 1941.

We had as our speakers, H. E. Millison and Dr. Royer of Calco Chemical Company, whose subjects were "Observation of Wool Dyeing, Part II."

Due to inclement weather the attendance was 76.

Respectfully submitted,

J. P. CONAWAY, *Secretary.*

REPORT, NORTH CAROLINA STATE COLLEGE STUDENT CHAPTER

ON January 17 the North Carolina State College Student Chapter was fortunate in having as its guest Henry H. Latham of the Chemical Processing Co., Charlotte, N. C., who spoke on "Sulfonated Oil" to several classes, and demonstrated method of manufacture and analysis.

On January 24, Norman Sixt and Mr. Wheeler of the Carolina Aniline and Extract Co. spoke on the principles, manufacture and use of soaking oils. All the speakers were kind enough to answer the many questions asked by the students.

Respectfully submitted,

GEORGE W. FUNDERBURK, *Secretary.*

MEMBERSHIP APPLICATIONS

Senior

James Wm. Barineau—Supt. of Processing Plant, Glenn Mfg Co., Lincolnton, N. C. Sponsors: A. R. Thompson, Jr., S. L. Hayes.

Robert John Bowman—Colorist, Calco Chem. Div., American Cyanamid Co., Boston, Mass. Sponsors: A. H. Sampson, M. H. Mettee, III.

Louis Francis Cowan—Textile Chemist, Calco Chem. Div., American Cyanamid Co., Boston, Mass. Sponsors: A. H. Sampson, M. H. Mettee, III.

Herschel C. Gass—Dyer, Montgomery Knitting Mills, Summerville, Ga. Sponsors: H. Schroder, F. F. Myers.

Robert Donald Harvey—Manager, Pepperell Mfg. Co., Lindale, Ga. Sponsors: L. L. Bamberger, R. J. McCamy.

Felipe Holschneider—Manager, Turicia S. de R. L., Mexico. Sponsors: C. D. Ehrengart, L. P. Brick.

Rinaldo A. Lukens—Vice President, in charge of Research, Continental Mills Inc., Philadelphia, Pa. Sponsor: L. A. Olney.

James L. McGowan—Supt. of Package Dyeing, American Thread Co., Willimantic, Conn. Sponsors: A. Veevers, R. W. Brewer.

Louis E. Moggio—Head Dyer and Finisher, Maygreen Piece Dye Works, New York, N. Y. Sponsors: R. Fitzgibbon, H. B. Marshall.

Louis Jack Sheps—Chief Chemist, Onyx Oil & Chemical Co., St. Johns, Que., Canada. Sponsors: C. D. Ehrengart, L. P. Brick.

Joseph J. Solodyna—Boss Dyer, Putnam Woolen Co., Putnam, Conn. Sponsors: A. J. Midwood, W. H. Zillessen.

Edwin G. Sutcliffe—Chief Chemical Engineer, Samuel Hird & Sons, Garfield, N. J. Sponsors: A. J. Royce, H. C. Chapin

Philip Schwartz—Chemist, and Foreman of Bleaching, Dyeing and Finishing, U. S. Lace Curtain Mills, Kingston, N. Y. Sponsors: A. J. Mease, W. L. Bleezarde.

Leo Wolf—Dyehouse Foreman, Up-to-Date Silk & Yarn Dyeing Corp., Brooklyn, N. Y. Sponsors: L. P. London, F. Schlayer.

J. Marks Abernathy—Acting Plant Manager, American Cyanamid & Chemical Corp., Charlotte, N. C. Sponsors: A. R. Thompson, Jr., S. L. Hayes.

Edward F. Britt—Chemist and Dyer, Kennedy & Britt, Philadelphia, Pa. Sponsors: R. W. Delaney, D. McGowan, Jr.

John H. Carey—Head of Converting Dept., Wellington

Sears Co., New York, N. Y. Sponsors: L. J. Roos, R. S. Lunt.

Lawrence L. Heffner—Chief Chemist, Wm. E. Hooper & Sons Co., Baltimore, Md. Sponsors: W. D. Appel, R. T. Mease.

Charles H. Huggins, Jr.—Research and Development, Pacific Mills, New York, N. Y. Sponsors: K. H. Barnard, J. F. Corbett.

H. M. Jackson—Asst. Supt., Pacolet Mfg. Co., New Holland, Georgia. Sponsors: E. M. G. Schroder, C. A. Jones.

Louis L. Jones, Jr.—Supt., Canton Cotton Mills, Canton, Georgia. Sponsors: C. K. Cobb, C. R. Gill.

Charles B. Musgrave—Foreman Dyer, Barrymore Cloth Co., Toronto, Canada. Sponsors: C. B. Fieldhouse, T. Rostron.

Hans H. Pacht—Supt., F. F. Hosiery Dyeing Dept., Cuban Silk Mills, Havana, Cuba. Sponsors: A. Lang, R. D. Howerton.

John A. Peel—Dyer, Pacific Mills, Worsted Div., Lawrence, Mass. Sponsors: L. N. Putnam, E. R. Rutter.

Donald Price—Director of Organic Research Lab., National Oil Products Co., Harrison, N. J . Sponsors: C. P. Gulick, A. F. Johann.

Peter P. Raman—Chemist, John B. Stetson Co., Philadelphia, Pa. Sponsors: A. E. Jones, Jr., J. M. Jester, Jr.

Israel Schwartz—Chief Chemist, Bendiner & Schlesinger Labs., New York, N. Y. Sponsors: E. Freedman, P. J. Kennedy.

Pehlam Eugene Smith—Manager of Bleaching and Finishing, Riverside & Dan River Cotton Mills, Danville, Va. Sponsors: J. B. Wray, D. S. Quern.

Alonzo C. Tacy—Dyer and Finisher, Jefferson Woolen Co., Knoxville, Tenn. Sponsors: F. L. Kibler, F. F. Myers.

Junior

John Charles Brooks—Dyer, Burlington Dyeing & Finishing Co., Greensboro, N. C. Sponsors: R. D. Howerton, A. M. Burt.

Max E. Nestler—Colorist, Calco Chem. Div., American Cyanamid & Chem. Co., Bound Brook, N. J. Sponsors: H. E. Millson, G. A. Morgan.

R. E. L. Winston—Plant Supt., American Cyanamid & Chem. Corp., Charlotte, N. C. Sponsors: A. R. Thompson, Jr., S. L. Hayes.

Paul T. Choate—Production Asst., Slatersville Finishing Co., Slatersville, R. I. Sponsors: R. F. Culver, H. A. Morrison.

Associate

William F. Henderson—Chief Chemist, Visking Corp., Chicago, Ill.

John V. Montgomery, Jr.—Technical Representative, Carbide & Carbon Chemicals Corp., New York, N. Y.

CORRECTION

"Tentative Method of Test for Resistance of Fabrics or Yarns to Moths" 1940 YEAR BOOK

SECTION 5(e) of the above test method, which appears on page 243, 1940 Year Book of the A.A.T.C.C., now reads:

"The fabric shall be considered satisfactorily resistant to moths if a quantity of excrement not over 6 milligrams is deposited on the untreated sample."

This paragraph should read:

"The fabric shall be considered satisfactorily resistant to moths if a quantity of excrement not over 6 milligrams is deposited by the larvae (Note) provided that under the same conditions a quantity of more than 15 milligrams of excrement is deposited on the untreated sample."

MEETING, PHILADELPHIA TEXTILE SCHOOL STUDENT CHAPTER

THE 27th regular meeting of the Philadelphia Textile School Student Chapter was held at the school on January 14, 1941.

Our Section Chairman, Ralph Hoey, called on F. L. Gilpin, a student of the school, to present a movie which was taken by him at the Cold Spring Bleachery of Yardley, Pa., during the summer of 1940. The movie covered the entire workings of the plant from the unloading of the grey goods from the freight car to the packaging of the finished product for shipment. Explanatory remarks were offered by Mr. Gilpin during the showing of various processes.

Chairman Hoey mentioned inspection trips to various mills to be taken by the Student Section in the near future, and also told of plans to present interesting speakers in the meetings to follow.

Respectfully submitted,

JOSEPH E. DIMSON, *Secretary.*

REPORT, LOWELL TEXTILE INSTITUTE STUDENT CHAPTER

DURING the first half of the 1940-1941 school year, the student chapter held three meetings:

On October 10, 1940, a business meeting was held during which a membership committee was elected. Ernest James was elected chairman and George Urlaub and George Hochschild as members.

On December 4, 1940, A. J. Gallagher of the Hillsborough Mills addressed the members on worsted stock, yarn, and slub dyeing. He discussed the advantages and disadvantages of each method of dyeing.

On January 15, 1941, Raymond Stevens of the Felters Co., Inc., gave a talk on the dyeing and finishing of felts. He also talked on various uses of felts.

Respectfully submitted,

SALVATORE J. PULIAFICO, *Secretary.*

Twenty-first

ANNUAL MEETING AND CONVENTION

CAROLINA HOTEL PINEHURST, N. C.

OCTOBER 31, NOVEMBER 1

Unemployment Register

Persons who are listed in the unemployment register should notify the secretary or the American Dyestuff Reporter IMMEDIATELY when they obtain employment.

OBITUARY

E. W. PIERCE

EDWARD WALLACE PIERCE, technician for the Ciba Company, Inc., died February 8th in his 64th year, in the Paterson General Hospital, Paterson, N. J., after a long illness. His home was in Clifton, N. J.

E. W. PIERCE

Dr. Pierce was born in Washington, D. C., and graduated from the University of Pennsylvania in 1897. He obtained immediate employment upon graduation and his long and varied career in the textile and dyeing field began in the laboratory of the Continental Dye Works. Then followed a period of 19 years' association as chemist and technician with the National Aniline & Chemical Co., Inc., the United States Conditioning and Testing Co., E. I. du Pont de Nemours & Co., Inc., and the Sandoz Chemical Works, Inc. He joined the Ciba Company, Inc., in 1927 and served this company as technician, conducted classes for the younger laboratory men and lectured on technical subjects both in this country and Canada.

He was an active member of the American Association of Textile Chemists and Colorists and delivered numerous papers at various meetings of the association. He was also a contributor of technical articles to this and other textile journals over a period of many years.

He is survived by his widow, Mrs. Eleanor Bozdorf Pierce; a son Edward Wallace Pierce, Jr.; four daughters by a previous marriage; a brother and five grandchildren.

M. R. MOFFATT

M. R. MOFFATT, chief chemist of R. Neumann & Co., Hoboken, N. J., died at the age of 63 at his home in Summit, N. J., in January, following a long illness.

He graduated from Columbia University in 1899, following which he was an instructor in inorganic chemistry at the Lowell Textile Institute. He later went with the Amoskeag Manufacturing Company and held the position of superintendent with that firm. In 1924 he came to R. Neumann & Co. as chief chemist and remained with them until the time of his death. He was a charter member of the American Association of Textile Chemists and Colorists.

He is survived by his widow and three sons.

• DECERESOL WETTING AGENTS

American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York City, has released a booklet entitled: "Deceresol Wetting Agents for Textiles." The foreword states that "one of the outstanding achievements of the chemical industry during the past decade has been the development of that remarkable class of synthetic products now generally grouped under the heading of 'surface-active materials'....The Textile Industry has very readily accepted these new materials, particularly wetting agents. The modern tempo of textile wet processing makes their use practically imperative. Present day consumer demand for the newer fibers and fabrics could hardly have been met without the aid of these auxiliaries...."

The trade name "Deceresol" has been assigned by Cyanamid to cover a group of wetting agents for the textile industry. The booklet describes the chemical composition, properties and applications of Deceresol OT and Deceresol AS. Copies are available upon request.

• GEIGY RELEASE

Geigy Company, Inc., 89 Barclay Street, New York City, has recently released a color card entitled *"Screen Prints on Pure Silk."* This card illustrates a range of colors especially selected for screen printing. The colors shown may also be used to good advantage on printing machines. The colors displayed may be grouped into two classes: (1) Colors possessing ordinary fastness properties; (2) Those possessing good all around properties to such requirements as resistance to light and washing. Methods of application are given. Color Card No. 305-D.

• CARBIC RELEASE

Carbic Color & Chemical Co., Inc., 451 Washington St., New York City, has released a pamphlet describing the following new product:—

Indigosol Brilliant Orange IRKL—a dyestuff said to be of a particularly desirable and extremely brilliant bright orange shade. It is said to possess excellent fastness to light and very good fastness to washing, chlorine and peroxide. The dyestuff is said to be easily soluble. It has low substantivity and is therefore very suitable for padding piece goods. On mixed fabrics and yarns of cotton and rayon or spun viscose rayon good union dyeings are obtained in padding, whilst when dyeing with salt addition the rayon is dyed a little stronger than the cotton. The product can be supplied sufficiently free from copper and manganese for vulcanizing styles. The printing is best carried out by the chlorate steaming process or by the nitrite process. Like the other Indigosols it can be printed alongside Rapidogen and Rapid Fast dyestuffs. As it is easily resisted with the usual print resists it is very well suited for the production of padded resist styles said to be of good fastness to washing and very good fastness to light.

• TO ADDRESS ANNUAL DCAT BANQUET

John J. Toohy, Chairman of the Drug, Chemical and Allied Trades Section of the New York Board of Trade, announces that the Honorable Paul V. McNutt, Federal Security Administrator, will deliver the main address at the Section's forthcoming 16th Annual Banquet which will be held on March 13, at the Hotel Waldorf-Astoria, New York City. Mr. Toohy said, "I feel sure the industry will be very pleased that Mr. McNutt has accepted our invitation, not only because of his long public record of service but also because of his close association with our industry as Administrator of the Federal Security Agency."

The title of Mr. McNutt's speech will be announced later and will have a definite bearing on the present national emergency.

With advance reservations far above previous years, all those interested in attending the dinner are urged to make their reservations promptly through John C. Ostrom, Secretary of the Section, 41 Park Row.

• DERMATITIS

Recently reported instances of skin irritation due to wearing of newer textile materials which have been finished by new and modern means have created considerable interest in the textile and consumer fields.

In order that the skin irritating effects of these textiles and the finishes thereon may be accurately judged, the United States Testing Company, Inc., has developed a series of specialized tests to determine the presence of harmful irritants and toxic agents in a wide variety of materials and fabrics such as dresses, hosiery, undergarments, overcoatings, suitings, furs, jewelry, upholstery, etc.

These tests were developed as a direct result of many retail store and consumer complaints as to irritating effects of a material or fabric on the skin, producing in

many cases, a severe rash or eczema, generally followed by an infection. This condition is known as dermatitis or inflammation of the skin, and is produced by the toxic material or primary irritant in the wearing apparel.

While experience has shown that the majority of dermatitis cases are due to a particular idiosyncrasy of the person it is also a known fact that in some instances certain finishes or other harmful ingredients can be present which are capable of producing an irritation.

The laboratories of the United States Testing Company, Inc., have developed three tests for the examination of these materials. These are (1) the Patch Test, (2) the Sensitivity Test (in animals) and (3) the Toxicological Effect Test (in animals).

In the case of questionable materials, Tests No. 1 and No. 2, the Patch and Sensitivity Tests, are recommended. Where dermatitis has been known to result from the wearing of a particular article, the Toxicological Test is urged.

In the many tests which have been conducted during the recent months, the Testing Company has found instances where primary irritants are present. These instances have been few, but indicate the need for a test on all new or questionable finishes. This is furthermore essential since the tests employed show that even minute traces of an irritating substance may be present which might result in a very definite skin reaction in use.

• NEW DARPRO HEADQUARTERS

Darpro Chemical Corporation announces removal to larger quarters at Main and George Sts., Newark, N. J., where modern equipment has been installed to provide for larger production.

• ELECTED PRESIDENT

Fred A. Mennerich, who conducts a textile laboratory which specializes in microscopy and photomicroscopy at 42 Roosevelt Avenue, Jersey City, N. J., was recently elected President of the New York Microscopical Society.

• NOPCO CEDARTOWN PLANT

Manufacturing operations will be begun within a month at the new, two-story addition to the Cedartown, Ga. plant of the National Oil Products Company of Harrison, N. J., it was announced recently by Charles P. Gulick, president and chairman of the board.

"Construction work on this important expansion of the manufacturing and warehouse facilities of the Cedartown plant is being rushed as much as possible," Mr. Gulick said. "Installation of machinery has already begun and the new plant will be all set to function within a month."

The new building, which is 73 feet by 96 feet, is being constructed by Wright and Lopez, Cedartown contractors, as an addition to the Metasap division of the National Oil Products Company. After completion, this expansion program will serve to more fully concentrate the company's manufacturing facilities for metallic soaps and allied products in Cedartown, according to Walter Kastner, resident agent at the Georgia plant.

It is stated that the growth of the Cedartown plant of NOPCO has been steady since operations were begun in 1937. In 1938, a first unit of the metallic soap plant was transferred to Cedartown from Chicago to be added to the capacity of the unit originally opened there. While no definite announcement has been made, it is understood that further expansions are planned for the immediate future.

There will be no acute shortage of trained workers when the new plant is opened, Mr. Kastner stated. A trained crew has been picked to take over as soon as the equipment is installed. Approximately 100 trained workers are on the company's Cedartown payroll, at present.

• WARWICK APPOINTMENTS

Anthony F. Costello, who has been connected with the Warwick Chemical Company for a number of years in the capacity of salesman and technical demonstrator in the New England territory, has been appointed Textile Sales Manager for the New England territory.

Paul Fabian has joined the technical sales staff of the Warwick Chemical Company as sales technician traveling in New England. Mr. Fabian was for many years manager of the Uncas Finishing Company at Mechanicsville, Conn., and for the last two years was manager of the United Merchant's Arkwright plant in Fall River, Mass.

• CHEMISTS' CLUB SYMPOSIUM

War on the sea, in the air and on the air waves will be the timely topic of the New York Chemists' Club's February Symposium on Wednesday evening, the 19th.

Participating will be Fletcher Platt, well-known authority on naval matters, Christopher T. Emmet, nationally known writer and speaker on international affairs, and Bernard Capehart, expert in aviation. John Edward Allen will lead the discussion.

There will be a display of scale models of various types of vessels in the United States Navy and also models of outstanding ships in the British and Axis navies.

Reception will start at 6:30; dinner will be at 7:00; speeches will start at 8:30.

• GENERAL RELEASES

General Dyestuff Corp., 435 Hudson Street, New York City, announces release of circulars describing the following products:—

Fast Light Yellow GGX Conc.—said to be a widely-used, level dyeing, fast-to-light acid yellow yielding bright shades of a greenish yellow. It finds considerable application in the production of combination shades on such materials as dress goods, carpet yarns, and upholstery, together with other fast-to-light and level dyeing acid colors. Circular G-221.

Wool Fast Orange GA—a product suited for the dyeing of wool, either as an acid color or as a chrome color. In the latter case it is dyed according to the afterchrome method. Wool Fast Orange GA is widely used as the orange component in chrome color combinations on loose wool, slubbing, yarns, and piece goods for the production of fast to wearing and fast to processing shades, in particular for olives and browns. Circular G-218.

Cellitazol ONS Soluble—an addition to the present range of water soluble, developed blacks for dyeing acetate rayon. It can be applied to fabrics or yarns and likewise to mixed fabrics containing acetate rayon. When diazotized and developed with Developer ON, this new brand produces jet blacks said to be of good fastness to light and of very good fastness to rubbing and to washing. Being a soluble type rather than a dispersed one, Cellitazol ONS Soluble penetrates piece goods, yarns, and tops quickly and completely. Circular G-222.

• A.S.T.M. SYMPOSIUMS

Two technical symposiums, one on Color—Its Specification and Use in Evaluating the Appearance of Materials, and the second on New Methods for Particle Size Determinations in the Subsieve Range will feature three sessions of the Spring Meeting of the American Society for Testing Materials to be held at The Mayflower, Washington, D. C., on Tuesday and Wednesday, March 4 and 5.

The details of developing the two technical symposiums are in the hands of special committees, the one on particle size measurement headed by C. E. Barnett, New Jersey Zinc Co., the one on color which is being held jointly with the Inter-Society Color Council holding its Annual Meeting in Washington on March 4 and 5 is headed by M. Rea Paul, Director, Technical Paint and Color Service, National Lead Co., the committee being a joint group of A.S.T.M.-I.S.C.C.

A Symposium on Color—Its Specification and Use in Evaluating the Appearance of Materials

The growing significance of color with respect to evaluating materials, the interest

of several standing committees of the A.S.T.M. in this subject, and the definite interest of the Society in the work of the I.S.C.C. resulted in sponsoring this symposium as a joint meeting. The committee in charge in addition to Mr. Paul as chairman includes the following: A. G. Ashcroft, Product Engineer, Alexander Smith and Sons Carpet Co.; W. E. Emley, Chief, Division of Fibrous and Organic Materials, National Bureau of Standards; C. E. Foss, Research Laboratories, Interchemical Corp.; W. R. Fuller, Technical Director, Grand Rapids Varnish Corp.; H. A. Gardner, Chemical Engineer, The Institute of Paint and Varnish Research; D. B. Judd, Physicist, National Bureau of Standards; R. S. Hunter, Junior Physicist, National Bureau of Standards; A. W. Kenney, Experimental Station, E. I. du Pont de Nemours & Co., Inc.; Paul Rapp, Associate Chemist, Public Roads Administration, Federal Works Agency; W. M. Scott, Chief, Cotton Chemical Finishing Division, U. S. Bureau of Agricultural Chemistry and Engineering, Southern Regional Research Laboratory.

The papers which will form the basis of discussion and the authors who will present them are as follows:

Introduction to Color—Deane B. Judd, Physicist, National Bureau of Standards.

Color of Transparent Materials—Francis Scofield, Chemist, National Paint, Varnish and Lacquer Assn., Inc.

Hiding Power and Opacity—R. H. Sawyer, Krebs Pigment and Color Corp.

Color Standards for Opaque Materials—I. H. Godlove, E. I. du Pont de Nemours & Co.

The Spectrophotometer in the Determination of the Color of Materials—A. E. Parker, Electrical Testing Laboratories.

Photoelectric Colorimetry — Richard S. Hunter, Junior Physicist, National Bureau of Standards.

• COLUMBIA EVENING TEXTILE COURSES

H. R. Mauersberger, who is in charge of the Evening Textile courses at Columbia University, announces the following schedule of courses and opening dates for the Spring Session of 1941:

Textile eZ12—*Identification, Analysis and Testing of Textiles (Advanced)*. Wednesdays, 7:30 to 9:20 p.m. G. R. Turner. Began February 5th. Room 410B, School of Mines.

Textiles eZ4—*Converting of Rayon and Spun Rayon Fabrics.* Thursdays, 7:30 to 9:20 p.m. H. R. Mauersberger. Began February 6th. Room 410B, School of Mines.

Textiles eZ14—*Textile Chemistry.* Lectures, 7:30 to 9:20 p.m. on alternate Fridays, began February 7th in Room 405, School of Business; Laboratory, 7:30 to 9:20 p.m., alternate Fridays, began February 14th in Room 209, Havemeyer Hall. A. Gyzander.

Textiles eZ2—*Cotton Goods Converting.* Mondays, 7:30 to 9:20 p.m. H. R. Mauersberger. Began February 10th. Room 410B, School of Mines.

Textiles eZ10—*Woolen and Worsted Manufacture.* Mondays, 7:30 to 9:20 p.m. Werner von Bergen. Began February 10th. Room 358, Chandler Laboratories.

Textiles eZ6—*Advanced Woven and Printed Fabric Design.* Tuesdays, 7:30 to 9:20 p.m. William H. Arlt. Began February 11th. Room 414, School of Engineering.

These courses extend for a period of 15 weeks and are open to all without entrance examination. Registration began Monday, February 3rd. Instructors may be consulted during the registration period from 7 to 9 p.m. in Room 301, School of Business Building, northeast corner of 116th Street and Broadway, New York. All inquiries should be addressed to the Director of University Extension, Columbia University.

• CHEMICAL DIGEST

The current issue of The Chemical Digest contains discussions of the following topics: Prophecy of the Future in Textiles; Chemical Abstracts; Flying Plastics; Chemical Detectives; Freak Work; The Traveling Laboratory; Insurance Problems; Raticides; and a warning about specific label warnings required by the Food and Drug Administration, as well as Paragrafacts, which presents tersely 24 recent developments of popular or technical interest. Copies are obtainable without charge by writing to Foster D. Snell, Inc., 305 Washington Street, Brooklyn, N. Y.

• CHEMICAL SOCIETY MEETING

A meeting of the American Section of the Society of Chemical Industry, jointly with the American Institute of Chemical Engineers, will be held on Friday, February 28 at 8:00 p.m. at the Chemists' Club, 52 East 41st Street, New York City. The meeting is to be a symposium on wetting agents. Dr. Lincoln T. Work will preside.

The topics to be discussed are as follows: "The Theory of Wetting Agents," Professor F. E. Bartell, Professor of Chemistry, University of Michigan; "The Structure of Wetting Agent Molecules," C. R. Caryl of the American Cyanamid Co.; "Uses of Wetting Agents," Dr. Samuel Lenher, Technical Manager of the Fine Chemicals Division, E. I. du Pont de Nemours & Co.

A dinner will be held at the Club prior to the meeting and starting at 6:45 p.m. Ladies and non-members of the cooperating societies are invited to attend both the dinner and the meeting.

Lower—A Recent Air View of Calco's Plant.
Upper—Calco in 1915

• CALCO MARKS TWENTY-FIFTH ANNIVERSARY

During December, 1915, and January, 1916, 25 years ago, the first shipments of Calco chemical products were sent on their way, according to a statement recently released by the Calco Chemical Division, American Cyanamid Company. It was in 1915 that the Calco Chemical Company organized and established itself in three small buildings on the outskirts of Bound Brook, New Jersey.

The company, originally founded to produce intermediate chemicals made scarce by the first World War, commenced a career of rapid growth almost immediately after starting operations. This growth, causing the company to quickly outgrow the three original buildings, has continued year after year. Today Calco's plant comprises over a hundred buildings and occupies 115 acres. Calco produced only two chemicals in 1915, but now it markets nearly a thousand chemical products. Although for the first few years Calco produced intermediates principally, the company went actively into production of dyes themselves in the early nineteen twenties. Today the application of Calco products is felt in many industries. Perhaps the principal of these are chemicals for color. These are used for the dyeing and printing of various textiles, for paper, leather, plastics, and for foods and drugs; color for fur, paints, linoleum. In addition, Calco products are widely used as pharmaceuticals. Sulfapyridine, sulfathiazole and sulfanilamide, the three drugs that have proved so effective against pneumonia and streptococcic infections, are among the pharmaceutical products developed by Calco. One authority has esti-

mated that, as a result of the use of sulfapyridine and sulfathiazole, the mortality rate from pneumonia has been reduced by approximately 70 per cent.

Growth in Research Activity

One of the most interesting phases of Calco's development since 1915 has been in research. From the very beginning, provision has been made for this activity. Twenty-five years ago the paucity of knowledge concerning chemical production, except that found in a few academic textbooks, made extensive laboratory work necessary even for such basic chemical products as aniline and beta naphthol. These early efforts on Calco's part succeeded in producing chemicals of unusual purity, including a water-white aniline.

As Calco has grown, so have these research activities. Today close to 250 scientists are connected with Calco's research program. Perhaps the most spectacular development coming from these laboratories has been the sulfanilamide family of drugs, already mentioned. Sensational as these drugs have been, there are new members of the same family that are being developed. These also promise to have a great value in furthering man's fight against disease and infection.

But is has not been in the pharmaceutical field alone that Calco's research efforts have been felt. A large portion of this staff of scientists is engaged solely with the application of dyestuffs and other chemicals to textiles. Only this past Summer an announcement was made concerning the application of fluorescent dyes to theater carpets.

In striking contrast to the desperate shortage of chemicals in 1915, the United States today is fully prepared with these needed products. The present-day Calco plant and staff typifies the rapid advancement made by this new American industry. Neither in regard to production facilities nor in the skill to progress is this country's chemical industry anything but well-equipped and well-manned.

● WINTER MEETING, INDUSTRIAL RESEARCH INSTITUTE

The great economic strides the South has made in recent years and the promise of future industrial greatness were analyzed by Eugene W. O'Brien, vice president, W. R. C. Smith Publishing Company, and manager "Southern Power and Industry," in an address before the members of the Industrial Research Institute and their guests gathered in Atlanta, Georgia, January 31 and February 1 for the Winter meeting of the Institute.

A desire to learn something of the South's growing industrial activity took this organization of industrial research directors into the region for their triennial meeting. Some 50 executives, including a representative group from southern industry, attended the two-day meeting, which had headquarters at the Atlanta Biltmore Hotel. A feature of the meeting was a visit to the laboratories of the Georgia School of Technology and the State Engineering Experiment Station in connection with it.

The Industrial Research Institute, an affiliate of the National Research Council, was organized three years ago for the purpose of improving efficiency and effectiveness in the management of industrial research through cooperation of its members. The membership is composed of industrial concerns maintaining research laboratories as a part of their organizations. The top executives in charge of research of the member companies represent them in the activities of the Institute. It has headquarters in Chicago.

Common problems of administrative efficiency facing the managers of industrial research today were the principal subjects of discussion during the two days of the meeting. H. Earl Hoover, Chairman of the Institute's Executive Committee and Vice President, the Hoover Company, opened the meeting on Friday morning, January 31st. K. P. Soule, Consulting Engineer, Tri-Continental Corporation, New York, led the discussion on "Investment of Profits in Research."

Following Mr. Soule's talk, C. N. Frey, Director, Fleischmann Laboratories, Standard Brands, New York, discussed "Training of New Research Employees."

At the luncheon on Friday, attended by Department heads of the Georgia School of Technology, Dr. Harold Bunger, Director, Chemical Engineering Department and the State Experiment Station, outlined the research activities being carried on at that institution and described its facilities. The members of the Institute and their guests spent the afternoon inspecting the laboratories and the special exhibits set up by the Student Organization of Professional Societies. Mr. O'Brien delivered his address on the "Industrial Development of the South and Its Trends" at an informal dinner in the Atlanta Biltmore Hotel that evening.

At the Saturday morning session, D. G. Smellie, Chief Engineer, the Hoover Company, North Canton, Ohio, described the system developed by his company for scheduling and controlling its research work.

The meeting concluded Saturday with a formal business session of the Institute, and a meeting of the Executive Committee, at which three new company members were announced; Dennison Manufacturing Company, Framingham, Mass.; Norton Company, Worcester, Mass.; and Lever Bros. Company, Cambridge, Mass. The next meeting of the Institute will be held in Pittsburgh during May.

● SOUTHERN TEXTILE EXPOSITION

Work upon the details of the plans for the 14th Southern Textile Exposition continues as March 31, the opening day, draws nigh. The number of exhibitors has now reached 200. Aside from the wide variety of machinery, installations, equipment and supplies on display, there will be several interesting meetings during show week.

Tuesday, April 1, the Greenville Rotary Club will entertain at luncheon all visiting Rotarians among the exhibitors.

Thursday, Mr. William A. Hanley, president of the American Society of Mechanical Engineers, will be the guest of honor at a luncheon of the members of the Greenville Section and visiting members.

Friday, a joint luncheon will be attended by the members of the Southern Textile Association, Textile Operating Executives of Georgia, and the Alabama Textile Operating Executives.

There is a feeling in textile circles that there was never a time in the history of the industry when replacements and renovations should receive more attention than now because of existing world conditions. The manufacturers who will exhibit at the Show include practically all the American makers of machinery for spinning yarn and weaving cloth, as well as nationally known makers of every type of equipment used by the industry. The Show will be open daily until 9 p.m., closing Saturday afternoon, April 5.

● CALCO BULLETINS

A dye used as a component in Olive Drab and Kersey Green shades for U. S. Government materials is featured in an announcement issued by the Calco Chemical Division, American Cyanamid Company. It is stated that Calcochrome Alizarine Blue Black B, alone and in combination with certain other dyes, will meet Government standards for fastness properties. In addition, it is said that this dye will withstand wet finishing operations satisfactorily.

Calcochrome Alizarine Blue Black B is recommended by the manufacturers more for light to medium shades than for blacks. It is applicable by the three commonly used chrome methods.

A direct brown dye with unusually good dyeing properties is being featured in another Calco bulletin. This dye, Calcomine Catechine 2G, is said to offer exceptionally good solubility, penetrating and level dyeing properties. For this reason this dye is useful for pad and jig dyeing and rayons. The dye is applicable particularly in the hosiery trade and for discharge effects upon piece goods.

Calcomine Catechine 2G can be used either as a self shade or with an aftertreatment. When aftertreated the color becomes faster to light and wet treatments.

The bulletin includes application data and fastness.

Copies of these bulletins may be obtained from Calco at Bound Brook, New Jersey.

• ANNUAL STYLE SHOW

Dr. Thomas Nelson, Dean of the Textile School at North Carolina State College, announced recently that the home economics departments of ten North Carolina colleges for women had accepted the Textile School's invitation to participate in the 14th Annual Style Show on Thursday, April 24th.

Approximately 160 young ladies, as a part of their classroom work in home economics, will design and make costumes from fabrics designed and woven at State College by Textile students. Each young lady whose work meets the standards of the institution she attends, will model her costume at the State College Style Show. Samples of over 200 fabrics manufactured by the State College Textile students have been sent to the cooperating institutions so that each student can select the pattern which she desires.

This year the cooperating institutions are: Appalachian State Teachers College at Boone; Elon College at Elon College; Flora Macdonald College at Red Springs; Greensboro College at Greensboro; High Point College at High Point; Louisburg College at Louisburg; Queens College at Charlotte; Meredith College, Saint Mary's School, and Peace Junior College at Raleigh.

Nylon—

(Continued from page 88)

at the back of the leg. The stockings are then ready for dyeing and for shaping by putting on a wood or metal form called a "board."

During these operations there are many handlings of the fabric, and it is easy to snag and pull out individual filaments unless suitable protection is given them. This is a problem with natural silk although it has a protective coating called "sericin" which binds the filaments together. The sericin softens during the wetting-out of the yarn and hardens again on evaporation of the moisture to give a firm fabric with all the loops held in place. It was necessary to find a material called a "size" which would do for nylon what sericin does for natural silk—adhere to the nylon, soften when wet with water without becoming tacky or sticky, redry to give firm positioning of the loops in the fabric, protect the filaments during the various handling operations, and be easily removed after it had served its purpose.

SETTING CHARACTERISTICS

One of the most interesting properties of nylon hose is its ability to take a permanent shape or set by means of a simple treatment with boiling water or steam. Figure 8 (right) shows a nylon stocking dyed in a manner normally used for silk or other fibers, and shaped on a standard boarding form. Note the wrinkles in the stocking. Figure 8 (left) shows a stocking which has been placed on the boarding form and subjected to steam at 5 pounds gage pressure (228° F.) for 5 minutes before being dyed. Each stocking has taken a permanent set; one obviously is desirable and the other is not. By giving the first stocking a treatment at a higher temperature for a longer time, the wrinkles can be removed. Generalizing, nylon under conditions of heat and moisture tends to take a permanent set which can be modified only by more drastic conditions—that is, higher temperatures and longer times.

This phenomenon is really an exaggeration of a similar phenomenon which takes place in the pressing of cotton, wool, or silk garments. To put a crease in a pair of trousers or to remove the wrinkles from a dress, it is customary to iron through a wet cloth or to use a press supplying the pressure and the moisture in the form of steam. These operations on the natural fibers are much more easily reversible than with nylon. A brief shower or even the heat and moisture of the body will remove creases from the best of suiting materials.

The use of this setting treatment before dyeing adds to the beauty and clarity of stitch characteristic of nylon hosiery. It possesses general application so that any woven or knitted nylon fabric can have its physical form established by an appropriate setting treatment.

CHEMICAL PROPERTIES

Nylon in the form of yarn, or otherwise, is difficultly soluble in most reagents. Phenols and formic acid are active solvents, but all the common dry cleaning solvents are without effect. While the resistance of nylon to mineral acids is not remarkable, it is quite resistant to alkalies even in fairly concentrated solutions and at elevated temperatures (Figure 9).

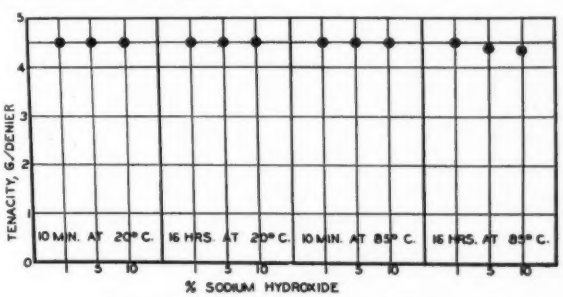

Figure 9. Alkali Resistance of Nylon

Nylon yarn and fabrics are practically nonflammable. Nylon has been exhaustively tested for physiological activity. It is completely inert and has found use in the form of surgical sutures. It is resistant to enzymes, mildew, molds, and moths.

While nylon shows affinity for a great many classes of dyestuffs, the best results to date have been obtained with the so-called acetate colors which were developed for the dyeing of cellulose acetate yarns and fabrics.

There is an infinite number of possible nylons, differing widely in their physical properties. Nylon yarn as currently offered has a high melting point, 253° C. (487° F.).

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[2]Marston and Barker, "Wool Quality," p. 211, London, H. M. Stationery Office, 1931.

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Wool Garments—

(Concluded from page 84)

oxidizing or reducing action. The alkalinity of the perborate bath does not increase with use and is not sufficient to cause appreciable damage. Of the reducing agents studied formaldehyde sulfoxylate causes the greatest damage, followed by bisulfite and hydrosulfite. This order may not be the same with respect to reducing power or capacity to strip dyes. Reduction in an hot alkaline medium causes severe damage. Alternate oxidation and reduction will increase susceptibility to damage by alkaline solutions.

TABLE 5

Effect of Alternate Oxidizing and Reducing Bleaching on Alkali Solubility of Wool

Reducing Agent	*No. of Perborate Overnight Bleachings*	*Alkali Solubilities (% Loss in Wt.)* *Reduction Followed by Perborate Bleaching*	*Perborate Bleaching Followed by Reduction*
Hydrosulfite	0	12.9	12.9
Hydrosulfite	1	22.3	18.1
Hydrosulfite	2	31.7	20.7
Hydrosulfite	3	36.7	20.7
Hydrosulfite	4	39.8	20.3
Hydrosulfite	5	47.1	25.8
Bisulfite and Acetic Acid	0	15.1	15.1
Bisulfite and Acetic Acid	1	28.0	17.6
Bisulfite and Acetic Acid	2	34.4	21.8
Bisulfite and Acetic Acid	3	46.3	25.8
Bisulfite and Acetic Acid	4	43.7	27.1
Bisulfite and Acetic Acid	5	49.2	21.6
Sulfoxylate and Acetic Acid	0	23.5	23.5
Sulfoxylate and Acetic Acid	1	47.0	30.2
Sulfoxylate and Acetic Acid	2	67.6	39.2
Sulfoxylate and Acetic Acid	3	81.1	39.4
Sulfoxylate and Acetic Acid	4	...	38.2
Sulfoxylate and Acetic Acid	5	84.0	37.8

LITERATURE CITED

[1]Harris, M. and Smith, A. L., J. Research NBS *17*, 577 (1936) RP 928.

[2]Harris, M. and Smith, A. L., Ibid. *18*, 623 (1937) RP 998.

[3]Sullivan, Public Health Reports *86* (1930).

[4]Waldschmidt, Leitz, and Schuckmann, Ber. *62*, 1891 (1929).

• BOOK REVIEW •

Skinner's Cotton Trade Directory of the World. 1940-41 *Edition. Published by Thomas Skinner & Co. (Publishers), Ltd., London, England, Montreal and New York. Price*: $7.00.

This is the eighteenth issue of this work of reference of the Cotton and Allied industries. The customary thoroughness in revision of details has been carried out in so far as has been possible owing to the prevailing conditions of war.

The Hosiery and Knit Goods Manufacturers section has also been completely revised and materially extended in an endeavor to meet the requirements of this specialized branch of industry.

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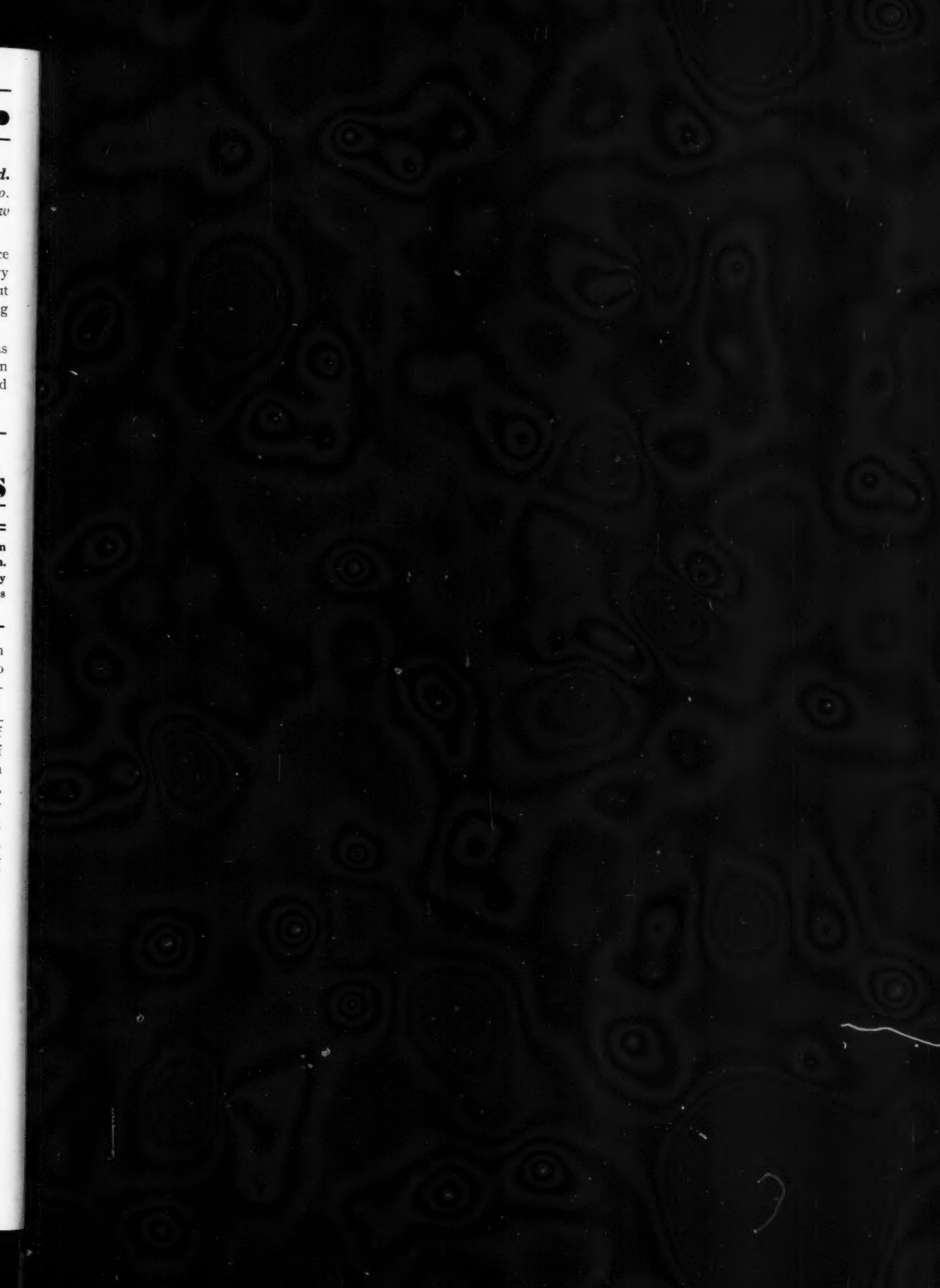
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